PUBLIC WORKS

Feb. 1960

CITY, COUNTY AND STATE

HOW A HYDROLOGIST Serves a Water Department page 87

Sewer District Serves Growing Population in 50,000-ACRE AREA page 94

A useful new text: PRINCIPLES OF SOIL ENGINEERING Part I—Soil Properties page 101

REFUSE BALING . . . An Idea That Deserves Consideration page 113

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WATER and SEWERAGE INDUSTRY and UTILITIES DIVISION
PUBLIC WATER SUPPLIES - Capital Investment, 1900-1975
ESTIMATED REPLACEMENT VALUE IN RELATION TO WATER USE AND POPULATION SERVED

Walter L. Picton is Director of the Water & Sewerage Industry and Utilities Division of the Business and Defense Services Administration of the Department of Commerce. More about him on page 16.

Wedge-Lock®

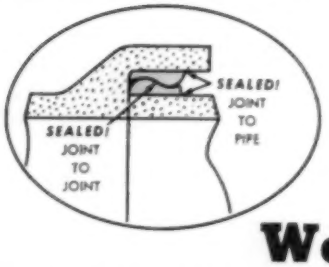
THE JOINT
with the

Full Circle
OF
PROTECTION

MINIMUM INFILTRATION!

ROOT-TIGHT SEAL!

FAST INSTALLATION!



When you install Vitrified Clay Pipe with Wedge-Lock Factory-Made Joints, you leave nothing to chance. Wedge-Lock pre-cast Joints are bonded to bell and spigot . . . snap together instantly . . . seal the entire circumference of the pipe to reduce infiltration and resist roots. Always specify Wedge-Lock, your Full Circle of Protection against infiltration . . . root problems . . . job delays . . . ultimate high cost resulting from costly repairs or maintenance.

Write to listed manufacturers for literature or an actual Wedge-Lock demonstration

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THE FACTORY-JOINTED CLAY PIPE AVAILABLE NATIONALLY FROM LOCAL MANUFACTURERS

Order Wedge-Lock from any of these Vitrified Clay Pipe Manufacturers:

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The Clay City Pipe Company....Uhrichsville, Ohio
The Evans Pipe Company.....Uhrichsville, Ohio
Graff-Kittanning Clay Products..Worthington, Pa.
Larson Clay Pipe Company.....Detroit, Mich.
The Logan Clay Products Company..Logan, Ohio
The Robinson Clay Product Co......Akron, Ohio
The Stillwater Clay Products Co...Cleveland, Ohio
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"from Chicago"

TWO ALL NEW Barminutor® COMMINUTING MACHINES

The BARMINUTOR Screening and Comminuting Machines provide continuous, complete, automatic comminution . . . at lower operating and maintenance cost than any similar device today.

The BARMINUTOR was developed to provide greater flexibility and wide application of comminution . . . developed from the original "Chicago" COMMINUTOR,* proven highly successful in thousands of installations.

BARMINUTOR Screening and Comminuting Machines eliminate unsightliness, nuisance and odor by continuously and automatically screening and cutting coarse sewage material without removal from the flow. Power requirements are lower than that required for mechanically raised screens and grinders. Manual attention is needed only for periodic inspection and lubrication.

*Trade-Mark

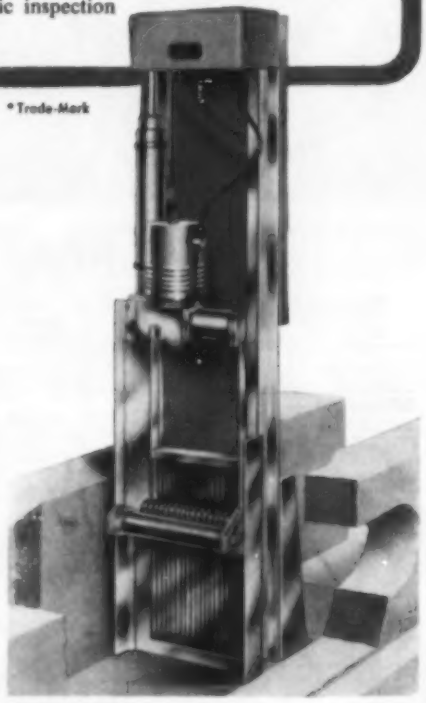
THE NEW MODEL "A-1" BARMINUTOR®

. . . . with All Electric Drive

- Extra cutting capacity without increase in power
- Shear bars allow additional cutting for peak loads
- Shear bars eliminate accumulation of rags and sewage solids on the screen
- Ball Bearings Shoes last longer . . . thereby greatly reducing maintenance
- Eliminated hydraulic hoses
- Neat, compact drive motor and panel

A DEVELOPMENT OF MORE THAN 25 YEARS SUCCESSFUL COMMINUTOR EXPERIENCE

Model "A-1" BARMINUTOR . . . for use in rectangular channel sections 4 to 8 feet wide . . . sized for flows of 10MGD and upwards.



Model "C" BARMINUTOR . . . for use in rectangular channel sections 1 to 3 feet wide . . . sized for flows of .09 to 15MGD.

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- Counter-weighted to minimize friction . . . increasing life of machine
- Stainless Steel Screen
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- Single Motor Drive . . . lower operating horsepower required
- Reversible cutting provides increased cutting capacity and extended life of cutters
- Rugged, economical design and construction

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Putting Ideas to Work

Chicago Pump Company

6222H DIVERSEY PARKWAY · CHICAGO 14, ILLINOIS

1960 50 YEARS CHICAGO PUMP COMPANY 1910

SPECIAL REPORT TO CATERPILLAR OWNERS:

CAT CATERPILLAR

Parts you can trust
...cost less per hour

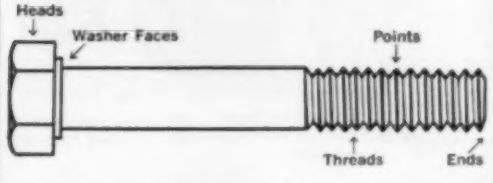
CAT ALL-PURPOSE BOLTS AND NUTS ARE STRONGER... HOLD LONGER... GRIP BETTER

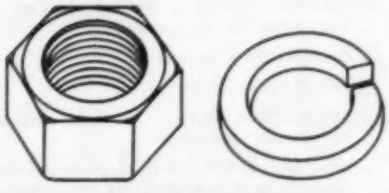
Ever twist a head off a bolt because it wasn't *strong* enough . . . or scrape your knuckle when your wrench "rounded off" the head because it wasn't *hard* enough? It's not likely to happen if you use Cat all-purpose bolts and nuts. They're highest quality in every way. For example, Cat bolts exceed Grade 6 in all requirements as rated by the Society of Automotive Engineers. Grade 5 is the average rating of bolts used in other earthmoving equipment.

WHAT GRADE OF BOLTS DO YOU USE?

Here's what's normally stocked at . . .	Hardware Stores, Automotive Outlets	Industrial Supply Houses, Other Mfr. Outlets	Special Order Only	Caterpillar Dealers
SAE	Grade 0-3	Grade 5	Grade 6	Exceeds Grade 6
Minimum Tensile Strength (Breaking point)	55,000-110,000 PSI	105,000-120,000 PSI	133,000-140,000 PSI	142,000 PSI
Hardness Rockwell Rating	RC 0-28	RC 19-32	RC 28-36	RC 30-38

If you need tougher, stronger hardware—get Cat all-purpose bolts and nuts. You can count on them to do a better job longer because they're stronger and harder than others.





HERE ARE OTHER CAT BOLT BONUSES YOU GET. *Heads* are higher and full size—easy to get wrenches on. *Flats* are hard and parallel—corners don't round off, are easy to grip. *Threads* are rounded at the roots and free from laps and burrs. *Points* are smooth and uniform. *Ends* are precisely rounded or chamfered—cross-threading doesn't occur. *Washer faces* are flat and have uniform thicknesses. *Heads and threads* are concentric to shaft—heads and nuts fit flush.

NUTS AND LOCK WASHERS are matched to every size bolt to give complete top-quality fasteners, too. Nut threads resist stripping. Corners do not round. Clean, smooth-fitting threads make installation fast and easy. Lock washers have smooth surfaces for maximum wear and strength.

When you need the best bolts and nuts to keep your machinery and other equipment together, see your Caterpillar Dealer. He has a large selection.

Caterpillar Tractor Co., General Offices, Peoria, Ill., U.S.A.

SERVICE TIP: Get your free copy of Caterpillar's bolts and nuts reference booklet at your Caterpillar Dealer today. It has the sizes, threads and part numbers listed for quick, easy ordering. Before buying any hardware, check Cat prices first.

CATERPILLAR

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PUBLIC WORKS

THE MOST USEFUL ENGINEERING MAGAZINE FOR CITIES, COUNTIES AND STATE

FEBRUARY, 1960 • Volume 91, Number 2

Municipal Hydrologist Provides First-Hand Data on Water Sources 87
This somewhat unique position provides Wichita, Kansas with a continuing study of existing and potential water supplies. G. J. STRAMEL

Waste Screenings Surface Shoulders on Bituminous Roads 90
Hopper conveyor fills low shoulders to make roads wider and safer. W. W. ANDERSON

Standards for Storm Water Facilities 91
New standards for storm water ditches established by the Metropolitan St. Louis Sewer District furnish guides for engineers and builders.

Operation of an Electronic Traffic Signal System 92
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County Treatment Plant for Industrial and Municipal Wastes 94
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Safe Water Supplies for Rural New Mexico 98
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New Cleaning Machines Cure Sewer Complaints 115
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Four men operate this new municipal installation which is rated at 12½ tons per hour.

Flood Control on a Limited Budget 118
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BPA

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ZF PREFABRICATED PUMPING STATIONS

THIS IS THE STATION THAT IS PREFABRICATED AND DELIVERED TO JOB SITE

READY TO OPERATE

A PACKAGED UNIT—completely shop-fitted with quality components throughout. Transported to job site ready for installation.

SIMPLIFIES LOCATION—underground operation permits use of existing public property such as parkways, etc. Saves cost of surface property and enclosing structure.

ECONOMICAL—saves costs and time. Prefabrication results in lower construction costs and less time at job site. Simply set in place, connect and start up.

COMPLETE DATA, SPECIFICATIONS AND DRAWINGS AVAILABLE—WRITE

ZF ZIMMER & FRANCESCON P.O. BOX 359, MOLINE, ILLINOIS

WALKER PROCESS PACKAGE PLANTS

UNIT DESIGNS FOR SMALL SEWAGE TREATMENT PLANTS

SIMPLE OPERATION — 90% automatic
ODOR FREE — no septic or stale operations
ADAPTABLE — concrete or steel tank construction

Details and preliminary plans are available to Consulting Engineers and their Architects, concerned with the design of small communities, subdivisions, institutions, schools, etc.

SPARJAIR Unit installed at a large Florida motel to handle 25,000 gpd combined sanitary and restaurant wastes. Note proximity of plant to motor court. Odor-free operation eliminates need of isolating plant.

SPARJAIR UNIT — Nested Contact Stabilization Plant — an easy to operate, low cost, small sewage treatment plant that is a model of simplicity. Designed on a new but proven principle, the contact stabilization process aerates and thoroughly oxidizes all odors in the sewage and overcomes previous objections to locating a plant near residences, shopping areas, schools, etc. Raw sewage settling tanks and septic digesters are eliminated. This plant utilizes a separate chamber for complete aerobic digestion (42% volatile remaining) of excess sludge.

Simple operation with minimum moving parts requires only part time attention. Capacities from 50 to 5000 population equivalent.

AEROBURN PLANTS — Package Aerobic Digestion; 24-hr. "Wet Burn" Aeration—designed for installations where economy is a prime factor and clarity of plant effluent is not vital. As with SPARJAIR units, the operation is odor free and practically automatic; with no delicate biological balances to achieve and hold.

Four standard sizes at 50, 100, 150 and 200 population equivalent.

SPARJPAC — Package Trickling Filter Plants — combines trickling filter and "wet burning" digestion in a two-story, compact design to provide best features of each type of treatment. SPARJPAC plants utilize DOWPAC® trickling filter media, developed by The Dow Chemical Company.

Design capacities range from 50 to 2500 population equivalent.

(DOWPAC is a registered trademark of The Dow Chemical Company).

WALKER PROCESS EQUIPMENT INC. factory • laboratories engineering offices **AURORA, ILLINOIS**

POINT OF VIEW

Adequate Lighting Can Help Prevent Crime

CRIME HAS BEEN in the headlines of newspapers in the New York City area. As a means of combating this lawlessness, a bill was recently introduced into the New York City Council which would require the equivalent of a 60-watt bulb to be placed on every building front at 50-ft. intervals. As pleasing as is this recognition of the basic values of good lighting, it is also an admission that the city has not done its part in providing adequate lighting for its streets. Instead it would require property owners to furnish and install the lights and keep them lighted continuously from an hour after sunset until an hour before sunrise. Naturally this will involve many difficult problems of inspection and enforcement and no apparent consideration has been given to the adequacy of the lighting that will be provided in case the measure becomes law. It looks to us as though the lighting industry has not done a sufficiently good selling job on the necessity for planned and properly engineered street lighting systems even if it has put over some of the broad values inherent in adequate street lighting.

Surface Water Supplies Always Need Chlorination

AN OUTBREAK of typhoid fever among consumers served by a municipal water supply system in New Hampshire has been reported. The story is familiar to old-timers—a surface supply and no chlorination—but perhaps strange to those of us who feel strongly that every water supply should be adequately chlorinated, whatever its source; and that the absence of chlorination is a throwback to the darker ages of public health.

There is available reliable equipment for applying chlorine and for regulating its application. The cost of insuring safety is small. The 14 typhoid cases, including one death, represent a heavy price to pay for this neglect of established and proven public health practice in safeguarding water quality.

Dog Bites and Health and Medical Expenses

IT HAS BEEN estimated that in this country more than 600,000 (some estimates say a million) people are bitten annually by animals, the great majority of them by dogs. The resulting medical and public health expenses amount to more than $5 million; the worry and anguish cannot be measured. About 50,000 people every year receive anti-rabies treatment as a result of bites. Figures show that less than one-third of the dogs in the community, under average conditions, have been vaccinated against rabies. In most areas there is a reservoir of unprotected animals which could result in a serious public health and governmental problem. Now is a good time to start planning for the coming summer season when the dog bite problem will be more acute.

Alternate Sources of Water Supply Are Highly Desirable

MORE WATER is already needed by many of our cities and steps should be taken promptly to provide these added supplies. In doing so, very serious consideration ought to be given to getting this added water from a new source—providing an alternate supply so that if by accident or sabotage one source is damaged, the other or others will function.

Civil defense authorities have recommended such a step. Your editor had extensive experience in this field during the war, finding that in far too many waterworks there was one place extremely vulnerable either to one man sabotage or to a possible accident. Though the large cities may seem most at fault in this respect, the situation appears to apply quite generally to large and small alike.

We hope that municipal officials, consulting engineers and state health departments will join in recognizing the great desirability for developing new and alternate sources of supply. This is an especially good time to consider and stress such needs for they can be provided in connection with the programs for more adequate water service under way now being urged by all leading agencies in the field.

Good Lighting Can Reduce that Triple Hazard

THERE ARE about three times as many fatalities per 100,000,000 automobile miles driven in the dark as in the daylight. In the winter months there are far more hours of darkness than of daylight. The triple hazard of after-dark winter driving can be reduced by good street and highway lighting. It may be too late to get these lights into service this winter; if so, now is the time to plan to reduce the accident toll next winter and the winters after that.

DON'T BE FOOLED BY INITIAL PIPE COSTS...

Certain factors concerning the type of pipe to be used for a proposed water or gas project must be examined carefully:

First
—how much does the pipe cost, compared to other types?

Second
—how often will it require repair?

Third
—how long before it has to be replaced?

After all, how much money do you really save if you buy the cheapest pipe . . . then have to repair it frequently . . . and *then* have to replace it within a decade or two?

You save with cast iron pipe

Sometimes the first cost of jobs where cast iron pipe is specified, is higher than similar projects using cheaper pipe. Yet, in the long run, cast iron pipe costs *less!* Here's why:

- Cast iron pipe rarely requires repairs. Its rugged construction, corrosion-resistant qualities and bottle-tight rubber-ring joints will withstand the most severe pressures. Once an investment is made in cast iron pipe, it is usually your first and last cost because of the absence of maintenance or repairs.

- Cast iron pipe is built to *last*—98 American cities will testify to that. They've had cast iron pipe installations in constant use for over a century! In fact, in Versailles, France, they're still using cast iron pipe water mains that were laid in 1664! Once cast iron pipe is in the ground, it stays there!

Don't be fooled by "low-cost" pipe. Insist on the pipe that will actually save you money over a period of years . . .

In Nebraska—Here a section of cast iron pipe is being relocated. Twenty-five years old, the pipe is still in excellent condition—has never required major repair . . . or replacement.

Rely on CAST IRON PIPE

In Indiana (above)—"All-weather" cast iron pipe is quickly installed despite wet trench conditions. Slip-on joints were easily assembled, with one workman using a crowbar.

In Kansas (above)—36" cast iron water main. Another part of this main was floated out of its trench by a heavy downpour. Later a 150 psi water test revealed no leaks in the slip-on joints!

In Pennsylvania (below)—This 16" cast iron pipe is being installed as fast as the trench hoe can prepare the trench.

Handy lengths and slip-on joints make cast iron pipe easy to handle, even in crowded neighborhood sectors; require less labor.

CAST IRON PIPE

THE MARK OF THE 100-YEAR PIPE

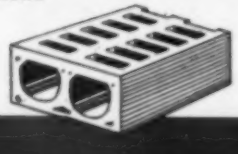
Cast Iron Pipe Research Association,
Thos. F. Wolfe, Managing Director, 3440 Prudential Plaza, Chicago 1, Illinois

MAKE A PROFIT FROM A PROBLEM

Photo, Underwood & Underwood

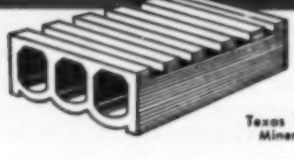
SPECIFICATIONS

Engineers can specify trickling filters with confidence and under a 50-Year manufacturers' Guarantee of the blocks not available elsewhere. Write any member of the Institute for a copy of new Specifications ASTM C 159-59T and the Guarantee.



BOSCO
Bowerston Shale Co.
Bowerston, Ohio

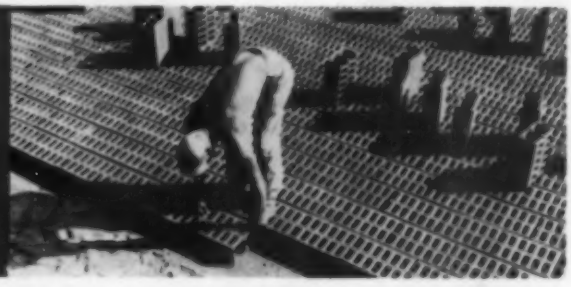
TFFI Trickling



TRANSLOT
Texas Vitrified Pipe Co.
Mineral Wells, Texas

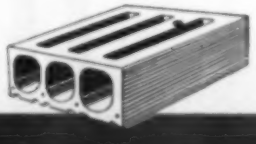
Attract new industries to your community by turning polluted streams into clean ones, fit for varied manufacturing processes and wider recreational uses. Anticipate demands by downstream neighbors for water supplies uncontaminated by industrial wastes and sewage. The solution is time-tested and simple: trickling filters with TFFI Specification vitrified clay block floors. Many trickling filters 30 years old and older are operating as well today as when first built. Costly remodeling and rebuilding have been avoided. Nearly 1,000 new ones went into service between 1945 and 1957. Acceptance mounts steadily.

WHY TRICKLING FILTERS SUCCEED



A major factor in their success has been the vitrified clay floor blocks underdrain systems. Clay is preeminent in its resistance to the ravages of acids, alkalis and bacteriological action. The TFFI Specification clay blocks not only serve right, they are *made* right—in modern plants under manufacturing controls of quality so rigid that substitute materials can not even approach them.

DICKEY
W. S. Dickey Clay Mfg. Co.
Kansas City 6, Mo.



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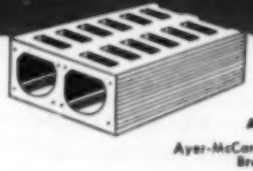
327 Fifth Ave.
Natco Corporation

Filter Floor Institute



ARMCRE
Ayer-McCarel Clay Co., Inc.
Brazil, Ind.

POMONA
Pomona Terra-Cotta Co.
Greensboro, No. Car.

TRANSLOT
Cannelton Sewer Pipe Co.
Cannelton, Ind.

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NON-CLOG PUMPS

TYPE KUC VERTICAL—For compact installation with flexible coupling drive...motor high above floor.

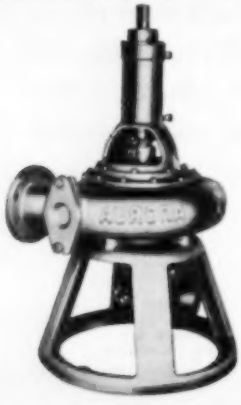
TYPE KCM VERTICAL—Utmost compactness...close-coupled design...low suction.

For handling heavy liquids . . . and solids in suspension. Ideal for public utility and industrial wastes.

Capacities to 9000 GPM • Heads to 150 feet • Solids size to 6 inches

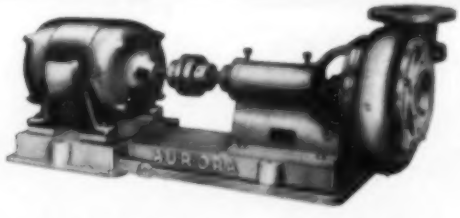
- Easy Installation
- Easy Disassembly
- Smooth—Quiet operation
- Hand cleanout provided in casings
- Detachable suction and packing covers
- Large Passageways
- Many optional features available
- Uniquely balanced impellers
- Engine or combination drives available
- Deep packing boxes

ALTERNATE IMPELLER DESIGN



TYPE KU VERTICAL—For flexible shaft drive...misalignment proof ...elevated motor protection against pit flooding.

TYPE KS VERTICAL SUMP—For heavy duty wet pit service. Complete unit engineered to specific pit requirements.



TYPE KGG HORIZONTAL—Rugged base mounted unit ...for use where suction conditions permit horizontal mounting.

ASK FOR...

MONO-VANE BULLETIN 121MV

NON-CLOG BULLETIN 121A

SUMP BULLETIN 104

AURORA Always PUMPS

AURORA PUMP DIVISION
THE NEW YORK AIR BRAKE COMPANY
630 LOUCKS • AURORA, ILLINOIS

LOCAL DISTRIBUTOR IS LISTED IN THE YELLOW PAGES OF YOUR PHONE BOOK

Holan heavy duty Elbow does double duty as derrick

Lifting workmen high into the air—or out—or down is only one of the uses of the Holan Elbow.

Equipped with an optional winch, the Elbow becomes one of the most versatile derricks in the field. It can be used for setting poles or lifting heavy loads and can be operated from either side of the body or the rear.

Because of 360° continuous rotation of the mast, the Holan Elbow used as a derrick can be located in any number of positions without moving the truck. This saves time — and money — in construction and maintenance work requiring derrick operation.

The winch can be installed on any of the three Holan Elbows: HD-42, HD-50 or HD-55. It will lift 4,000 pounds and set poles up to 65 feet in length.

Mounted on the mast, the winch is hydraulically driven from the Elbow hydraulic system with power from the power take-off or from a separate gasoline engine.

In the Holan Elbow you have an aerial elbow that reaches up as high as 55 feet and a serviceable, versatile derrick —*all in one.* Write us for complete details—or get in touch with your Holan Field Representative.

Holan Corporation, 4100 West 150th Street, Cleveland 35, Ohio
Plants in Cleveland, Ohio; Griffin, Georgia; Phoenix, Arizona

Holan

Subsidiary of THE OHIO BRASS COMPANY

HOLAN

INTRODUCING

SHORT NEW CHEVROLET TILT CAB TRUCKS

72" BUMPER TO BACK OF CAB

They're built like "tilts" should be built—that's the story on this new line of trucks from Chevrolet. All of the special advantages of tilt cab design—compactness, extra payload capacity, easy maintenance, maneuverability—are better than ever before. And Chevy brings you some extra-special benefits, too!

MOST COMPACT IN ITS CLASS for higher profit payloads. Six-foot-bumper-to-back-of-cab dimension gives you more cargo space than ever before (almost 60 cubic feet more than other tilt cab trucks!). You can carry bulkier payloads in a bigger body; and you can carry *heavier* payloads, too, because the extra space means more of the load weight can be carried by the front suspension. This *shorter* design means longer profits!

BEST MANEUVERABILITY. With comparable body sizes, new Chevrolet tilt cabs are as much as 2½ feet shorter overall than conventional models and save up to 48 inches in wheelbase. This *minimized* length and wheelbase pay off in *maneuverability*—easy handling in tight places that will save you time and work every day.

ROOMIEST CAB in its class! New Chevy tilt cabs are big and comfortable inside. A full 6½ feet wide, with plenty of head room and leg room for rangy drivers. And there's the safety of "picture window" visibility through a sweeping glass area.

REVOLUTIONARY TORSION-SPRING RIDE standard in all models! Independently suspended front wheels step nimbly over bumps . . . and friction-free torsion bars soak up jolts of all sizes. New variable-rate rear springs complement the new front suspension perfectly. The result is an amazingly smooth ride that assures higher safe cruising speeds, more work done every day . . . plus longer truck life with lower maintenance costs.

And in every new Chevy tilt cab model, new tougher built rear axles and brawny new box-section side-rail frames team up with the best kind of big truck power.

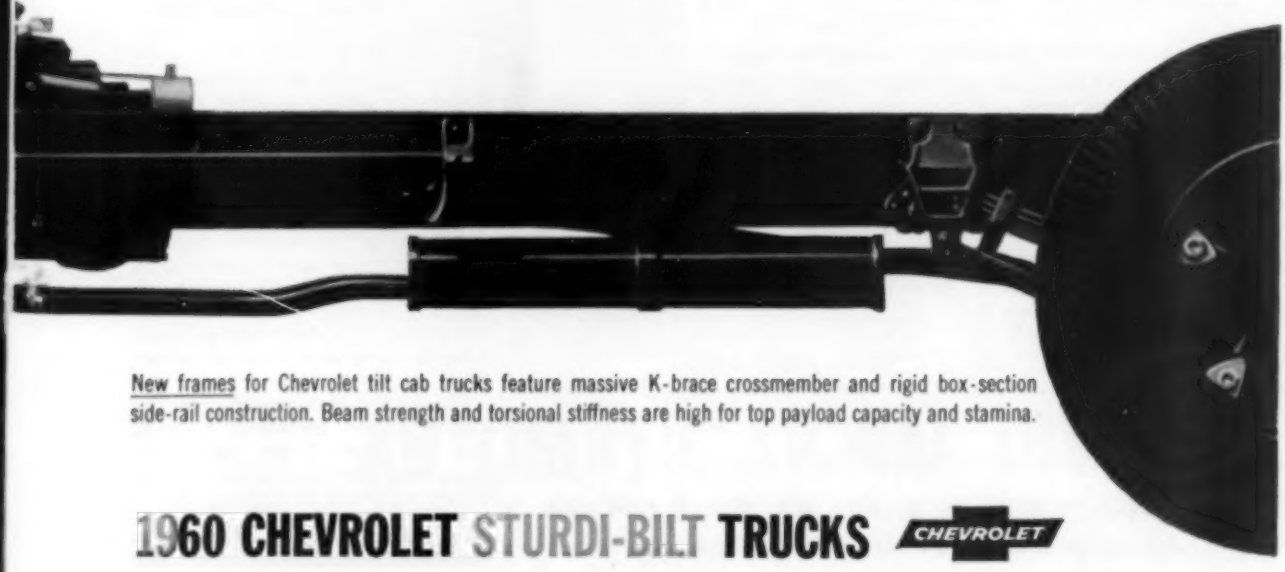
New ease of maintenance slashes upkeep costs. Maintenance can be performed in as little as half the time required for conventional trucks!

Stationary control island is solidly mounted on truck frame. Short linkage is dependable and easy to adjust.

Torsion-spring tilting hinge takes the work out of tilting. A tough torsion bar counterbalances the cab's weight and makes cab tilting a breeze.

Triple-safe locking system provides protection against accidental tilting. Keeps cab securely anchored down when you're under way.

20 NEW MODELS IN 5 SERIES. Five rugged medium- and heavy-duty series offer G.V.W.'s up to 25,000 lbs. Money-saving power is provided by Chevy's famous truck-built engines—economy-minded 6's for all models up to 22,000 lbs. G.V.W. and tough V8's for bigger models. Chevy makes tilt cab design *work* like never before; you can see for yourself by visiting your Chevrolet dealer right now! . . . Chevrolet Division of General Motors, Detroit 2, Michigan.

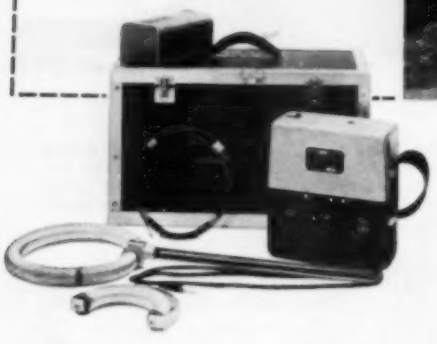


New frames for Chevrolet tilt cab trucks feature massive K-brace crossmember and rigid box-section side-rail construction. Beam strength and torsional stiffness are high for top payload capacity and stamina.

1960 CHEVROLET STURDI-BILT TRUCKS CHEVROLET

Maintain Coating Application Standards

INSPECT WITH A TR HOLIDAY DETECTOR!



EP HOLIDAY DETECTOR
Portable, "damp-climate," pulse type holiday detector for coated surfaces.

To obtain maximum protection and hold maintenance costs to a minimum, inspect protective coating with a Tinker & Rasor Holiday Detector and make repairs before backfilling. Minutes spent inspecting the pipe with a Tinker & Rasor Holiday Detector while the ditch is open can save days making repairs later on. Clearly, if protective coating is desirable, the best possible protective coating is *most* desirable.

Every holiday in your protective coating increases the current requirements of cathodic protection. The result is constantly increasing maintenance costs.

Insure your pipeline's future with inspection by Tinker & Rasor Holiday Detectors. Write today for technical data and bulletin.

Engineering Note:
To insure a successful application, your specification should include TR Holiday Detector inspection. Write for specification guide.

DISTRIBUTORS:
Falcon Line Products Corp., Kearny, New Jersey
Crutcher-Rolfs-Cummings, Inc., Houston, Texas
Remco Manufacturing Co. Inc., Tulsa, Oklahoma
Bob Herrick, New Cumberland, Pennsylvania
Canadian Equipment Sales & Service Co. Ltd., Edmonton, Alberta, Canada
Export Agent: Frazar & Hansen Ltd., San Francisco, Calif.

Quality control for coating application

TR TINKER & RASOR

417 Agostino Road, P.O. Box 281 • San Gabriel, California

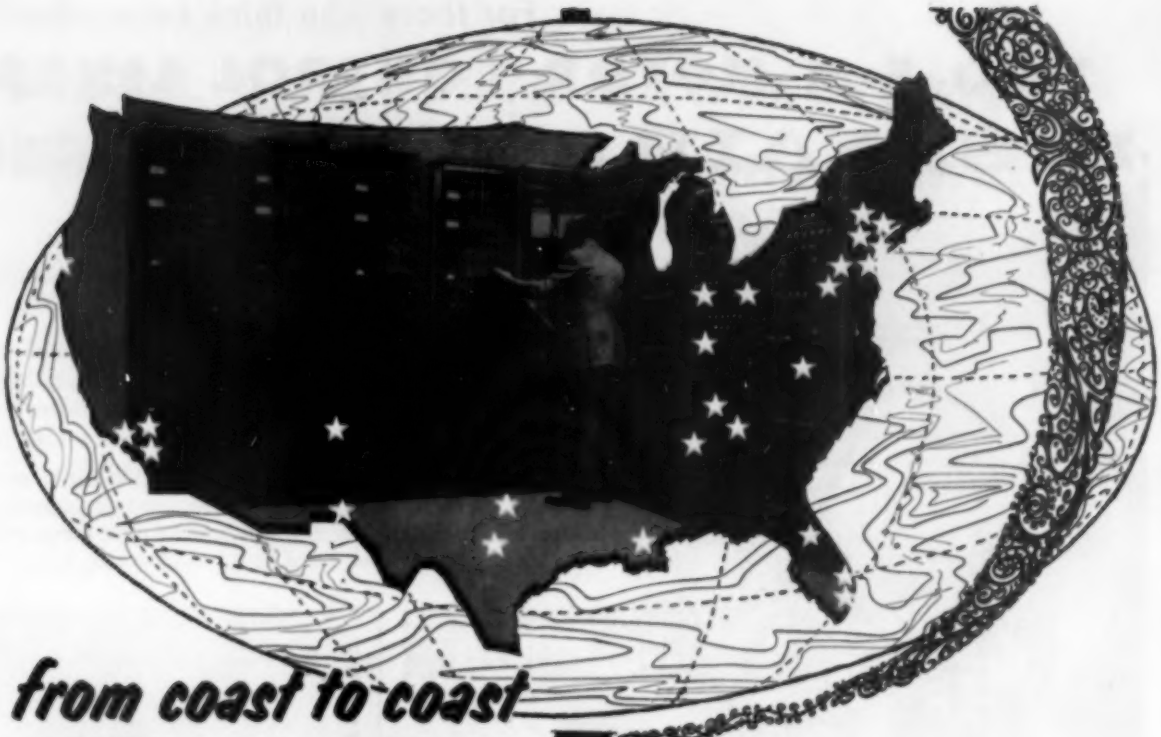
Walter L. Picton is Director of the Water and Sewerage Industry and Utilities Division, Business and Defense Services Administration, U.S. Department of Commerce. As Director, Mr. Picton is responsible for the planning, directing, evaluating and coordinating of business services and defense activities and programs of the Division. Under his direction the Division collects data on past activities of the industry and provides estimated projections of requirements for future growth and expansion.

Mr. Picton has held this position since January 1958, having been Deputy Director of the Division since 1953. Prior to that time he was Special Assistant to the Director, Water Resources Division, National Production Authority. Previous U.S. Government experience includes such positions as Water and Sewage Works Specialist, Office of Defense Production Administration; and Water and Sewage Works Adviser, National Security Resources Board.

Mr. Picton is a Vanderbilt University graduate in Civil Engineering. He served with the 114th U.S. Field Artillery, AEF in World War I. Following graduation, he was engaged for 17 years in engineering practice, mostly in water and sewerage, with various consulting firms and was in private practice in Nashville, Tenn.

Mr. Picton is a registered professional engineer in Tennessee and Kentucky, and a member of the ASCE, AWWA, and FSIWA. In 1956, he was U.S. Representative on the NATO Civil Defense Working Group for Water Utilities in Paris, France. He is the Department of Commerce Representative on the Interagency Advisory Committee to the Senate Select Committee on National Water Resources. He is the author of articles and publications on water and sewerage works too numerous to mention here.

Mr. Picton is a member of the Chevy Chase Methodist Church. He and Mrs. Picton have two daughters, Mrs. Frank Haynes and Nancy Elizabeth Picton, age 15.



from coast to coast

PR *system of traffic signal control*

Here is the ultimate in coordinated traffic control for cities and towns. Detectors at strategic locations sample key traffic flows for the centrally located Electro-Matic® Master.

***Highly developed computing circuits** of the Master analyze the data, and send instructions to the all-electronic PR Locals at each intersection being coordinated. The most effective timing pattern for changing traffic conditions is maintained continuously . . . automatically . . . reliably.*

For full details, write for Bulletin E-224.

TRAFFIC ACTUATED ®

AUTOMATIC SIGNAL DIVISION

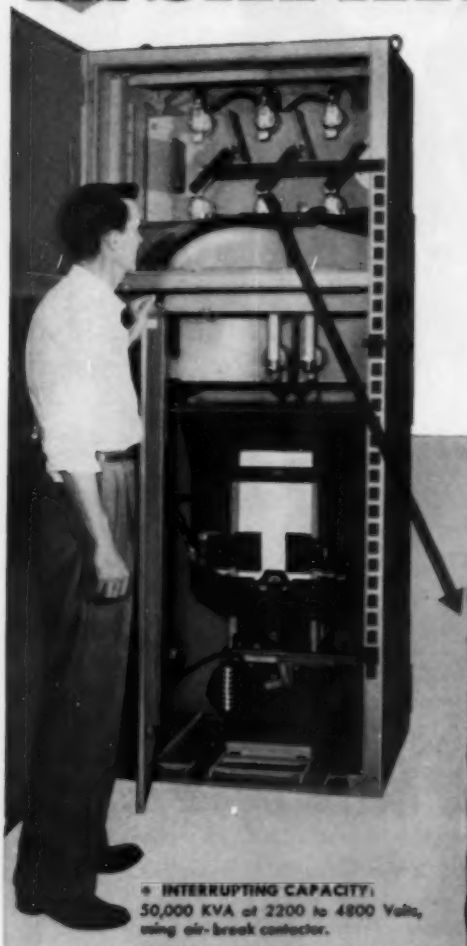
EASTERN INDUSTRIES, INCORPORATED

NORWALK • CONNECTICUT

For those who think twice about

TWO E-M MOTOR CONTROL LINES

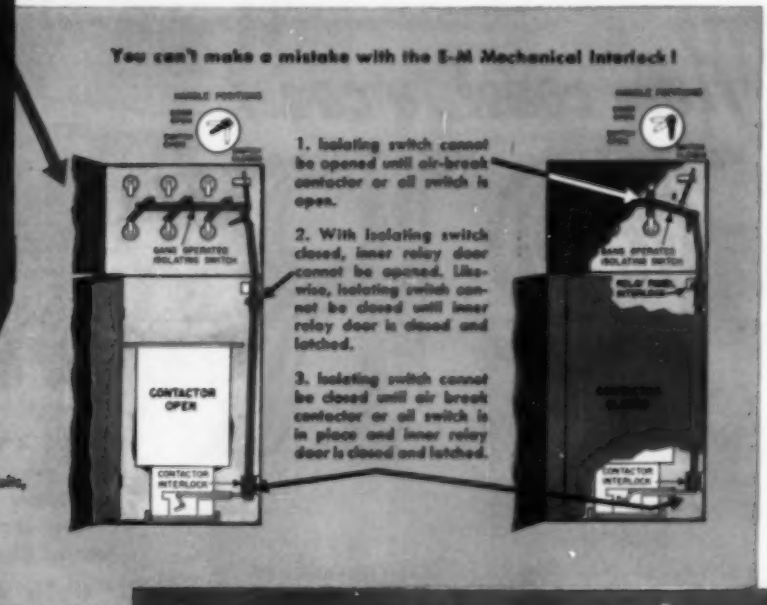
E-M SAFAIR Magnetic Control (NEMA CLASS E-1)



* INTERRUPTING CAPACITY: 50,000 KVA at 2200 to 4800 Volts, using air-break contactor.

Compare these features with those of your present controls

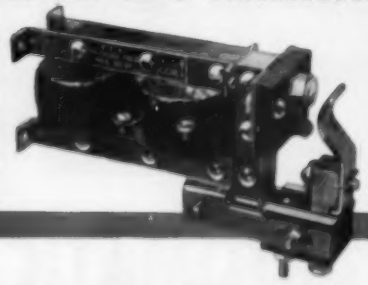
1. **Complete Personnel Safety** with a foolproof system of mechanical interlocking between gang-operated isolating switch, oil switch or air-break contactor, and compartment doors.
2. **Complete Motor And Control Protection.** Skillfully engineered and applied components are carefully coordinated to protect both motor and control over complete design range of overload and fault conditions.


You can't make a mistake with the E-M Mechanical Interlock!
1. Isolating switch cannot be opened until air-break contactor or oil switch is open.
2. With isolating switch closed, inner relay door cannot be opened. Likewise, isolating switch cannot be closed until inner relay door is closed and latched.
3. Isolating switch cannot be closed until air break contactor or oil switch is in place and inner relay door is closed and latched.
CONTACTOR OPEN
CONTACTOR INTERLOCK

E-M SAFETY-GANG ISOLATING SWITCH of SAFAIR Control is externally operated, internally interlocked as detailed in color and diagrams above, right.

SAFAIR features a 50,000 kva (NEMA Class E-1 maximum rating) air-break contactor suitable for repetitive motor starting and rapid switching in a complete line of squirrel-cage and wound-rotor induction motor controls and synchronous motor controls.

PFR* for Simple, Reliable SYNCHRONOUS MOTOR CONTROL



Safair- and Safuse-controlled synchronous motors pull into step smoothly and powerfully every time. E-M-invented "Polarized Field Frequency Relay system of synchronous motor

3300-TPA-2189

ELECTRIC MACHINERY

Originators of the safety-gang

their men and motors...

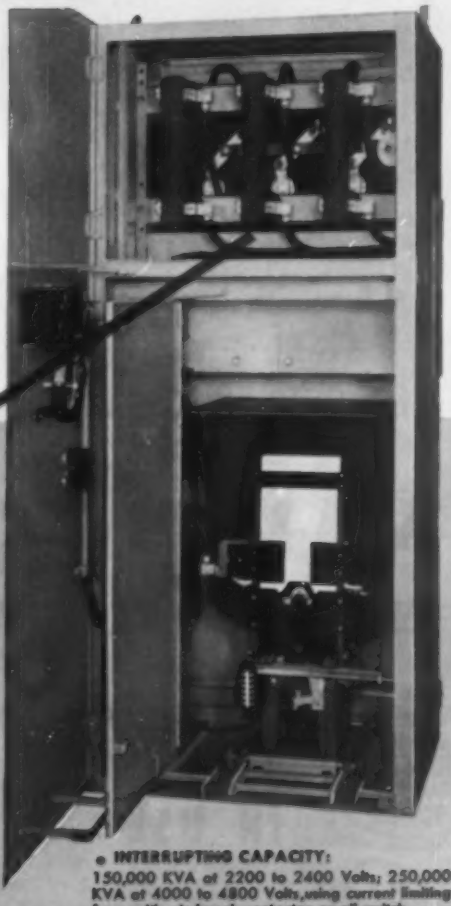
OFFER COMPLETE PROTECTION!

E-M SAFUSE Magnetic Control (NEMA CLASS E-2)

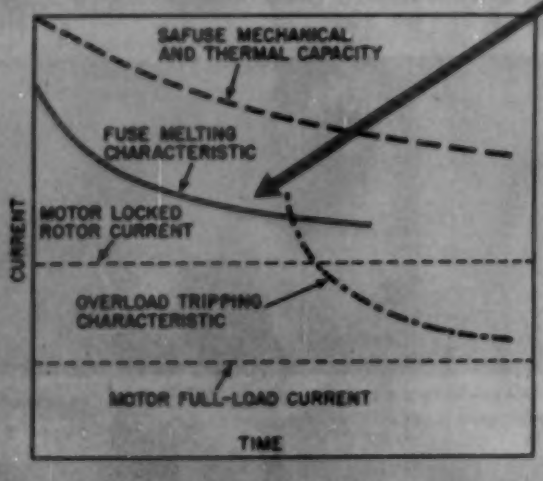
3 **Complete Front Accessibility.** Controls may be placed in rows, back-to-back or back-to-wall—no access required to back or sides.

4 **Complete Space Utilization.** Imaginative E-M engineering has provided a highly compact control design without compromise on safety or performance, and with provision to accommodate modifications.

5 **Complete Modification Line.** You can tailor the control to fit your exacting requirements—nearly 100 options and special features available.



• INTERRUPTING CAPACITY: 150,000 KVA at 2200 to 2400 Volts; 250,000 KVA at 4000 to 4800 Volts, using current limiting fuses with air-break contactor or oil switch.



starting and synchronizing is sensitive to the electrical condition of the field winding, applying field excitation at proper rotor angle for maximum synchronizing torque with minimum current inrush . . . and it's coupled with E-M's modern field failure protective system.

FAST ACTING FUSES *plus* E-M Safety-Gang Isolating Switch in SAFUSE are the best possible combination for complete motor and control protection thru NEMA Class E-2 maximum ratings. The current limiting fuses provide short circuit protection and are carefully coordinated with overload relays as shown in diagram above.

Complete information and helpful application data are available from your E-M Field Engineer. Call him and write the factory for publications 242A and 249.

SAFUSE GIVES YOU CHOICE OF AIR-BREAK CONTACTOR OR OIL SWITCH

For highly repetitive duty use the roll-out air break contactor. But for less frequent starting—or in areas of severe dust, dirt, moisture, or corrosive fumes—the roll-out oil switch is recommended.

E-M MFG. COMPANY MINNEAPOLIS 13, MINNESOTA

disconnect high-voltage fused control

Excellent visibility in spite of rain—photo shows pavement of emulsified asphalt with limestone single-application seal coat.*

SAVINGS IN CONSTRUCTION plus SAFETY IN USE

Also taken in the rain — asphalt pavement (dense-graded high-type plant mix) without seal coat.*

The three photographs on this page are not retouched; they were taken by the same photographer from the same car with the same camera (with the same lens and speed setting) under similar weather conditions. If you are looking for good visibility and adequate skid-resistance along with economy of construction, it is a simple fact that *there is no lower cost way to get those properties* than by the proper use of emulsified asphalts and aggregates in seal coats. For further information, get in touch with your nearest McConnaughay Licensee (listed on the page facing this ad) or contact the main office below.

Raining again — conventional rigid-type pavement.*

**Details on request.*

K. E. McCONNAUGHAY LAFAYETTE INDIANA

EMULSIFIED ASPHALT *PLANTS AND PROCESSES*

McCONNAUGHAY LICENSEES
Operating K. E. McConnaughay Emulsified Asphalt Plants

FLORIDA
E. A. Mariani—Emulsified Asphalt
Hooker's Point, Tampa

ILLINOIS
Emulsions, Inc.—*Lawrenceville*

INDIANA
Bituminous Materials Co.
P. O. Box 1140, *Terre Haute*
Wabash Valley Asphalt Co.
Terre Haute
Walsh & Kelly
R. R. No. 2, *Gary*
Brookman Construction Co.
17th & Gharkey Sts., *Muncie*
Fauber Construction Co.
Lafayette
Asphalt Materials & Construction, Inc.
960 East 22nd, *Indianapolis 2*
Bituminous Materials Co.
E. Swihart St., *Columbia City*

IOWA
Bituminous Materials & Supply Co.
409 Fifth Street, *West Des Moines*
Plants: *Spirit Lake, LeMars, Carroll, Algona, Lehigh, Davenport*

KENTUCKY
Emulsified Asphalt Co.—*Kuttawa*

LOUISIANA
Bituminous Materials Co.—*Metairie*
Serving Alabama, Mississippi, and Louisiana

MAINE
Doherty and Swearingen Co.
53 Main St., *Yarmouth*

MASSACHUSETTS
James Huggins & Sons, Inc.
Medford & Commercial, *Malden 48*

MICHIGAN
Bituminous Materials Co.
318 Atlantic St., *Bay City*
Bituminous Materials Co. *Escanaba*
Bituminous Materials Co.
416 S. Water St., *Jackson*

NEW YORK
Knight Paving Products, Inc.
1655 Union Rd., *Gardenville*
Knight Paving Products, Inc.
Vine Street, *Ithaca*
Knight Paving Products, Inc.
1980 East Avenue, *Rochester 10*
Knight-Bitumen Corp.—*Watertown*
Albany Asphalt & Aggregates
75 State St., *Albany*
Bimasco, Inc. *(2 plants)*
312 Brook Street
Bayshore, L. I., N. Y.

SOUTH CAROLINA
Seaco, Incorporated
2700 Industrial Drive, *Columbia*

TENNESSEE
Asphalt Products Co., Inc.
Powell Ave., *Nashville 4*

CANADA
T. J. Pounder & Co., Ltd.
1474 Wall St., *Winnipeg, Man.*
Three plants

Eastern Representative:
John A. Dow
157 Church St., *New Haven 10, Conn.*

COST ACCOUNTING FOR STREETS AND HIGHWAYS

This is a Procedure Manual on cost accounting for Streets and Highways, prepared by the National Committee on Urban Transportation and published by the Public Administration Service, 1313 East 60th St., Chicago 37, Ill. It covers general cost accounting, maintenance, capital outlays and finances of fixed assets. Under Highways are supervision, snow and ice removal, cleaning, lighting, sidewalks, bridges and viaducts, tunnels and other structures; also covered are storm drainage, street trees, pension and other payments and workmen's and unemployment compensation. There are listings of principal operations, with applicable units; 35 pages; cost not stated.

3-DIMENSIONAL MAP OF THE UNITED STATES

This is a plastic relief map, 28 x 18 inches, of all 50 States. It shows in many colors 4,000 geographic names, 2,000 cities and towns, 200 mountain ranges and peaks and other features. The scale is 117 miles to the inch. An index, also of tough plastic slides out from the back. There is a plastic frame so the map is ready to be hung. Also available is a 60 x 40-inch world relief map. The US 28 x 18 map sells for $9.95. Aero Service Corp., 210 E. Courtland St., Philadelphia 20, Pa.

INDUSTRIAL WASTES—COTTON TEXTILES

This is an industrial waste guide to the cotton textile industry. It describes the processes involved and gives considerable data on the sources, characteristics and pollutional effects of the process wastes. Remedial measures are also treated quite fully, and cover in-plant control including reduction of waste volume, reduction of process chemicals, recovery and reuse of chemicals and substitution of chemicals having lesser pollutional effects. The sections on treatment of processing wastes is general. The guide was prepared by a Committee representing various groups and is available as Public Health Service Publication No. 677; 23 pages; for sale by Supt. of Documents, Government Printing Office, Washington 25, D. C., 25 cents.

EUROPEAN TECHNICAL DIGEST MONTHLY

Every month some 1,000 technical journals from 13 different countries and in 11 different languages are searched and appropriate information on processes, methods, apparatus and materials is assembled in English in this publication. The Nov., 1959, issue contains 102 pages half as large as this page. The scope of material is wide so that little in any one issue will be applicable to a specific field of work. Price is $12 per year. European Productivity Agency, 3 Rue Andre-Pascal, Paris XVI, France.

PHILADELPHIA LAW REPORT

This is an interesting 16-page report of the legal work underlying major city government activities in health, safety, police and fire. No charge; Division of Public Information, 201 City Hall, Philadelphia 7, Pa.

CONCRETE PAVEMENT SUBBASES & JOINTS

There are three papers in this 53-page bulletin. The first is "Performance of Concrete Pavements as Related to Subbase Construction Methods." This is 10 pages long, illustrated. The second paper, on "Joint Construction in Concrete Pavements," is 9 pages long and is illustrated. The third, "A Theoretical Approach to Design of a Road Joint Seal," is 25 pages long, with diagrams and charts. An appendix gives an outline of a bond-ductility test for evaluation of sealers. Highway Research Board, 2101 Constitution Ave., Washington, D. C., price $1.

INVENTORY OF MUNICIPAL AND INDUSTRIAL WASTE FACILITIES

The Public Health Service has announced PHS Publication No. 622 which lists physical and operating data on all municipal and some industrial waste treatment facilities in the United States as of Jan. 1, 1958. The publication is presented in 9 volumes, arranged according to the 9 administrative regions of the Dept. of Health, Education and Welfare. The entire set is available from the Superintendent of Docu-

HIGHWAY WEED PROBLEMS LIKE THESE

CAN BE ELIMINATED LIKE THIS WITH AMIZOL WEED KILLER

and Amizol combinations

Using Amizol alone, or in combination with other weed killers, state and local highway departments are instituting successful and complete vegetation control programs along thousands of miles of roadsides, guard rails, gravel shoulders, bridge abutments, center strips and embankments.

Amizol combinations provide longer control of more broadleaf weeds and grasses than any product used alone. They produce rapid knockdown of existing vegetation, better kill of deep rooted perennials and keep the treated area free of weeds all season long.

Costs for total vegetation control are considerably less with Amizol combinations . . . by 30 percent or more. You use less chemical to kill more weeds. Your "spraying season" is longer, just as long as weeds are green and actively growing.

For information on how to begin a practical highway weed control program, write for free booklet describing uses, application data and chemical formulations of Amizol—produced by Amchem Products, Inc., originators of 2,4-D and other basic weed killers.

AMCHEM AMIZOL

Amchem and Amizol are registered trademarks of
AMCHEM PRODUCTS, INC. (Formerly American Chemical Paint Co.)
AMBLER, PA. • St. Joseph, Mo. • Niles, Calif.

ments, Government Printing Office, Washington 25, D. C., for $10.25. Individual volumes for the separate areas are also available at prices ranging from 60 cents to $1.75.

DEPARTMENT OF AIRPORTS, LOS ANGELES

This is an attractive and informative report of the Los Angeles, Calif., Dept. of Airports. It gives information on construction and expansion, on the proposed new terminal and shows traffic growth. Financial operations and an operating statement are included.

PAVEMENT DESIGN IN FROST AREAS

This 131-page bulletin is the first of a series on the subject of pavement design in cold areas. This bulletin contains five papers on the general subjects of frost heave mechanism, moisture effect, frost penetration and soil effects. Highway Research Board, 2101 Constitution Ave., Washington, D. C. $2.60.

PHOTOGRAMMETRY DEVELOPMENTS

The developments and applications of photogrammetry are covered in six pages on county general highway maps, highway route location, planning, survey adjustments, overlap and flight height and data for earthwork quantities. 68 pages, $1.20, Highway Research Board, 2101 Constitution Ave., Washington, D. C.

NIGHT VISIBILITY AND ROAD LIGHTING

There are seven papers in this 64-page publication covering various phases of roadway night visibility, including discussion of signal light colors and proposed changes in the standards; and vision levels of night road illumination. Highway Research Board, 2101 Constitution Ave., Washington, D. C. $1.20.

MEMPHIS CIVIC CENTER REPORT

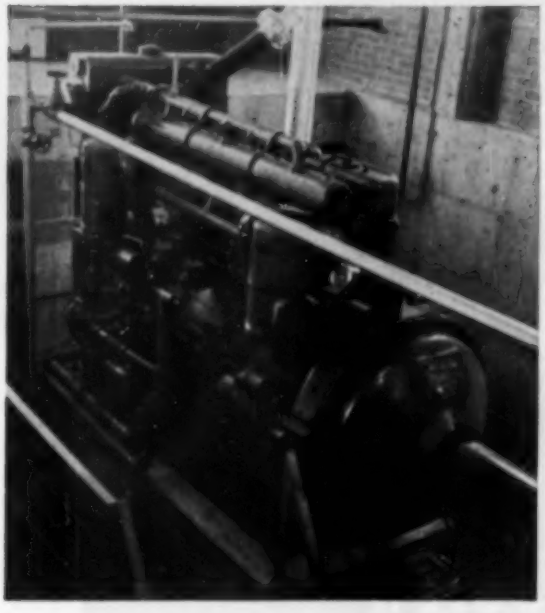
Prepared by the League of Memphis Architects, Inc., this report contains site and building studies that form a basis for the design of the proposed Memphis Civic Center. This is a remarkable job; it will be followed soon by the final report which will include the proposed design of the Civic Center, with recommendations on programming and financing. It was prepared by the League of Memphis Architects, Inc., 264 North Lauderdale St., Memphis 5, Tenn.

ROILINE ENGINES (Formerly LE ROI)

* The trade mark LE ROI is used under license from Westinghouse Airbrake Co., the trade mark owner.

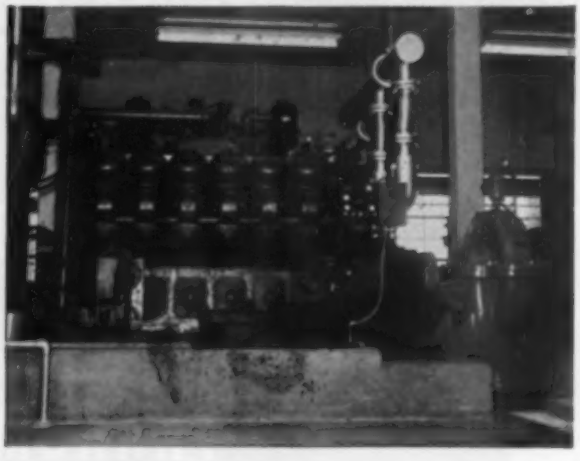
POWER FOR MUNICIPAL PLANTS

Three ROILINES pull the pumps at Oklahoma City's Lake Hefner Municipal Filtration Plant.



Model F-1500, maximum horsepower 215 at 1200 rpm on natural gas.

Model L-3460, maximum horsepower 595 at 1350 rpm on natural gas.



BASIC ENGINE CHARACTERISTICS*

GASOLINE OR NATURAL GAS					600	800	1000	1200	1400	1600	1800	2000	2200	2400
MODEL	Bore & S.	Cyls.	Displ.	Torque–rpm	BRAKE HORSEPOWER AT ENGINE SPEEDS INDICATED									
H540	4½ x 4¼	8	540	430- 900	...	64	82	99	115	130	143	155	164	170
HB44	5¼ x 4⅜	8	844	637-1500	...	106	135	165	191	215	237	255	270	278
F1500	6¾ x 7	6	1503	1090- 650	125	165	200	215						
H2000	6¾ x 7	8	2004	1485- 650	170	225	270	290						
L3000	6¾ x 7	12	3006	2200- 650	250	335	405	435						
L3460	7¼ x 7	12	3468	2570- 900	285	391	492	568	595 @ 1350 RPM					
L4000	7.54 x 7.5	12	4000	2930- 900	325	446	560	645						

*With oil pump, water pump, magneto, air cleaner, carburetor, and exhaust muffler. Hp shown is maximum.

SEE YOUR ROILINE ENGINE DISTRIBUTOR

ARIZONA, Casa Grande, Engine Service Company, Inc.
ARKANSAS, Paragould, Wonder State Manufacturing Co.
CALIFORNIA, Long Beach, Engine & Equipment Company
COLORADO, Denver, Emrick & Hill Engine & Equipt. Co.
KANSAS, Garden City, Carson Machine & Supply Co.
LOUISIANA, New Orleans, Southern Engine & Pump Co.
MICHIGAN, Reed City, Hafer Engine Company
NEW YORK, Syracuse 6, J. C. Georg Corporation
OHIO, Columbus 19, Cantwell Machinery Company
OKLAHOMA, Oklahoma City 9, Carson Machine & Supply Co.
PENNSYLVANIA, Bradford, R. R. Reck Company
TEXAS, Houston 1, Southern Engine & Pump Co. (also in Beaumont, Corpus Christi, Dallas, Edinburg, Kilgore, San Antonio)
Lubbock, Farmers Supply
Odessa, General Machine & Supply, Inc.
Wichita Falls, Nortex Engine & Equipment Co.
WYOMING, Casper, Emrick & Hill Engine & Equipt. Co.

424-B-1

WAUKESHA MOTOR COMPANY, WAUKESHA, WIS. / **New York • Tulsa • Los Angeles**
Factories: Waukesha, Wisconsin and Clinton, Iowa

NOW! FOUR NEW MOTOR GRADERS

that will put you out front for the BIG JOBS in the 60's

BIGGER · HEAVIER · STRONGER

ECONOMICAL TO OPERATE AND MAINTAIN · CONSTANT MESH TRANSMISSION

NEW MODELS	8-D	9-D	10-D	11-D
HORSEPOWER	83	100	125	160

PEAK PERFORMANCE AND ECONOMY FEATURES THAT PUT THESE MODELS OUT FRONT!

see Huber-Warco for the finest in grading and rolling equipment

HUBER-WARCO COMPANY

Single member frame designed to absorb heaviest shocks and strains. High arch design improves visibility, provides more room to maneuver blade.

Ruggedly built circle with three big wearing shoes. Designed to protect gear teeth from all loads except turning force.

Circle turn completely gear driven.

Weight where it counts. Two-thirds of machine weight on drive wheels.

Easy, positive steering with hydraulic booster activated by six pounds' hand pressure.

90-degree blade control on either side without leaving cab.

360-degree blade rotation without removing scarifier teeth.

Power sliding moldboard, optional, for faster work around abutments, stakes, and other obstructions.

Full-floating rear axle carries no machine weight.

Large, roomy deck with all controls within easy reach.

Deluxe cab, optional, has 18% more glass for greater visibility.

Six speeds forward and reverse; optional creeper gear adds three more speeds in each direction.

Moving one lever changes direction in same gear.

Other constant mesh transmission features include (1) easy shifting, including range shift, at all speeds (2) shift rails interlocked to prevent multiple engagement (3) pressure flood lubrication (4) ball and tapered roller bearings throughout transmission and final drive (5) helical transmission gears for quiet operation (6) machine-cut, case-hardened alloy steel transmission shafts and gears.

MARION, OHIO
U. S. A.

HUBER
WARCO

TANDEM ROLLERS

MAINTAINER

3 WHEEL ROLLERS

a cinch to

The "boys" are back . . .!

by popular demand!
And three years' additional experience proves that Tyton Joint pipe has more than lived up to everything they said about it in 1957.

Tyton Joint® pipe is *almost* as easy to install as our hillbilly friend indicates. Only one accessory needed . . . a specially designed rubber gasket that fits into the bell of the receiving pipe. A push or two and the connecting pipe compresses the gasket . . . seals the joint bottle-tight and permanently.

No bell holes. No waiting for weather. Tyton Joint pipe can be laid in rain or wet trench. It's so simple, in fact, even an inexperienced crew quickly becomes expert.

U.S. CAST IRON PIPE FOR WATER, SEWERAGE AND

install!

You'll be hearing more about this ingenious new Tyton Joint. Why not get the facts firsthand . . . and now?

Write or call. We'll be glad to give them to you.

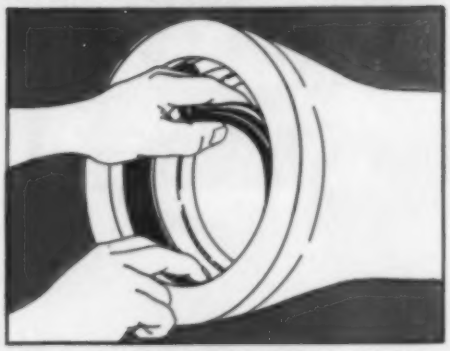
U. S. PIPE AND FOUNDRY COMPANY
General Office: Birmingham 2, Alabama

A WHOLLY INTEGRATED PRODUCER FROM MINES AND BLAST FURNACES TO FINISHED PIPE

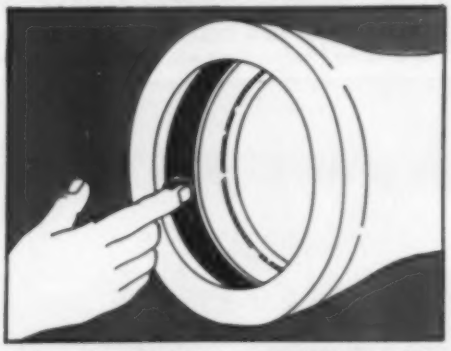
INDUSTRIAL SERVICE CAST IRON

U. S. TYTON JOINT

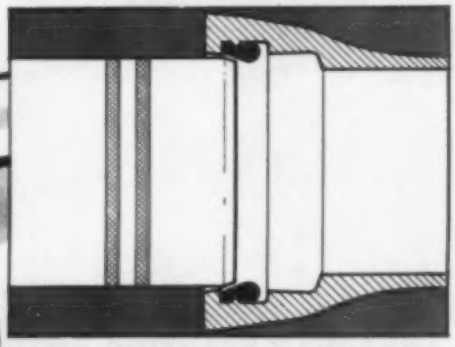
ONLY FOUR SIMPLE ACTIONS



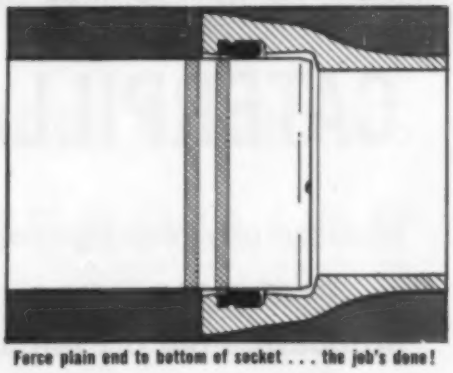
Insert gasket with groove over bead in gasket seat



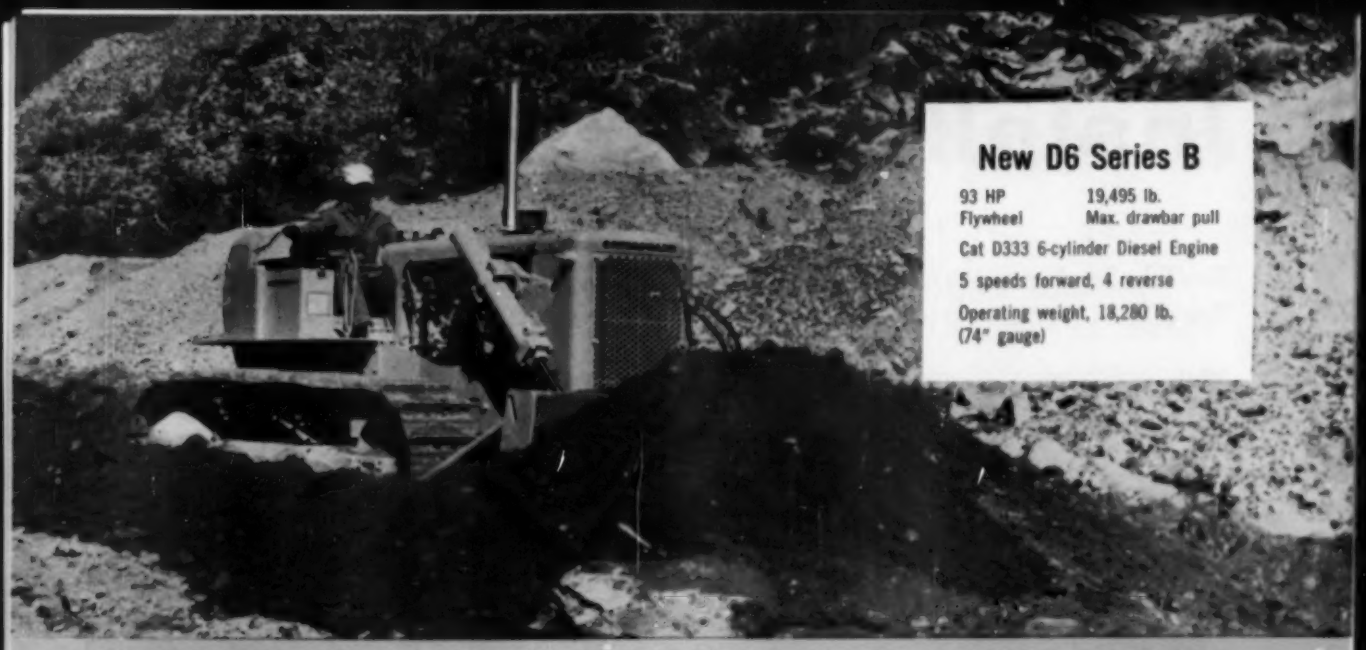
Wipe a film of special lubricant over inside of gasket



Insert plain end of pipe until it contacts gasket



Force plain end to bottom of socket . . . the job's done!



New D6 Series B

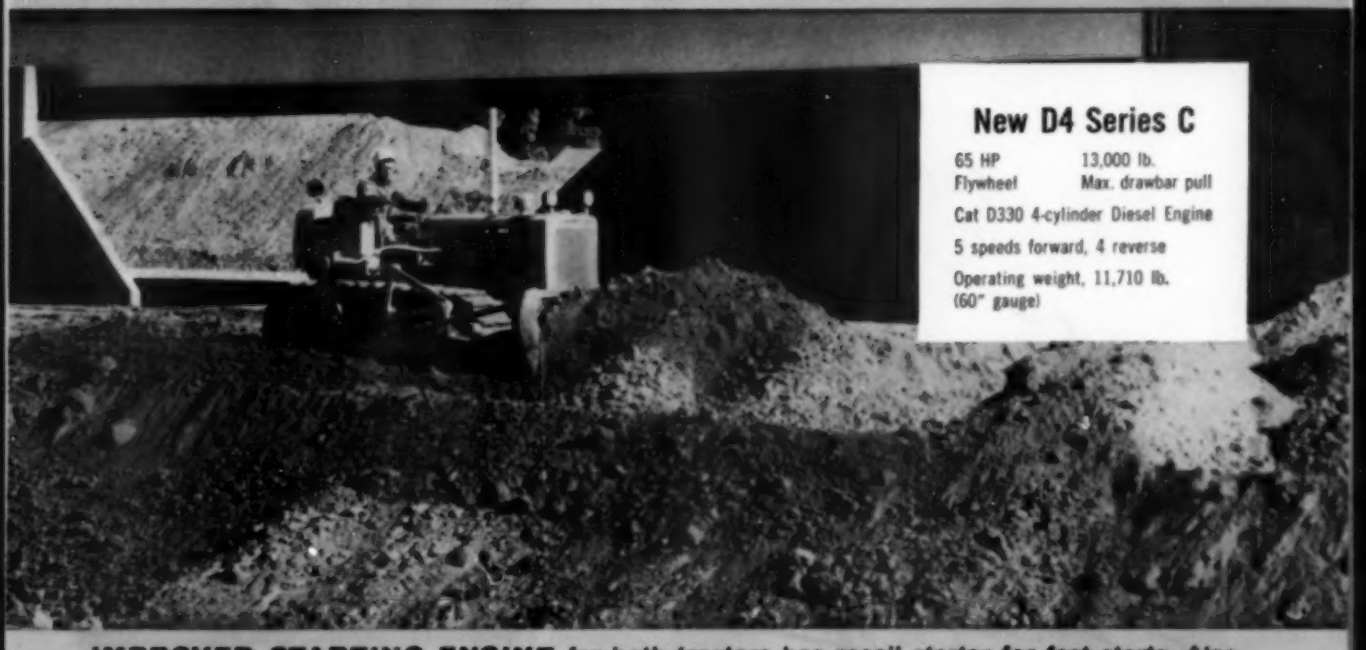
93 HP Flywheel — 19,495 lb. Max. drawbar pull

Cat D333 6-cylinder Diesel Engine

5 speeds forward, 4 reverse

Operating weight, 18,280 lb. (74" gauge)

RUGGED MATCHED ATTACHMENTS for the D6 and D4 include Bulldozers, Tool Bar, Scraper, Rock Rakes, Winches, K/G Blade, Rippers and others.



New D4 Series C

65 HP Flywheel — 13,000 lb. Max. drawbar pull

Cat D330 4-cylinder Diesel Engine

5 speeds forward, 4 reverse

Operating weight, 11,710 lb. (60" gauge)

IMPROVED STARTING ENGINE for both tractors has recoil starter for fast starts. Also 12-volt in-seat starting available. 24-volt direct electric starting optional.

CATERPILLAR ANNOUNCES the

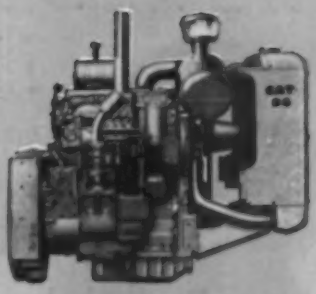
completely redesigned to give you more production per tax dollar

There's no time like now to upgrade your equipment spread. These two new tractors not only look different—they are different. Each, in its own class, answers your needs for higher production and greater operating economy. Some of their important new features are described on these pages. In addition to these improvements, each machine provides other famous Caterpillar features... the dry-type air cleaner,

D6 93 HP 6-cylinder Engine
Maximum drawbar pull, 19,495 lb. The D333 Engine provides power with dependability for a long life of economical operation.

New Caterpillar Diesel Engines deliver 25% more lugging ability

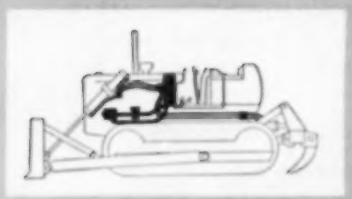
For the D6 and D4, two completely new Cat Diesel Engines. 25% more lugging ability. New compactness with new ruggedness. Famous Cat fuel injection pumps in new, easily serviceable housing. New direct acting governor that makes quick fuel adjustments, picks up loads fast. New, improved gasoline starting engine.



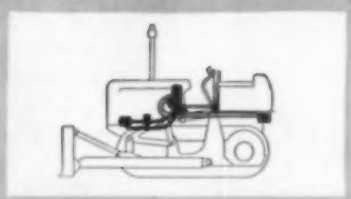
D4 65 HP 4-cylinder Engine
Maximum drawbar pull, 13,000 lb. New design of the D330 results in smooth, vibration-free performance in all speed ranges.

New integral hydraulic systems put more power where you need it

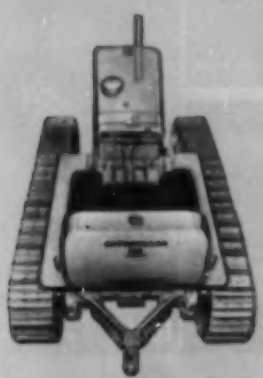
More work power at the tools—that's one of the big advantages of these new Cat hydraulic systems. Under-the-hood mounting of tank, pump and valves permits convenient routing of hydraulic lines to bulldozer or implement cylinders, frees front and rear for mounted equipment. Center-pivoted cylinder mounting on D6 gives increased blade lift/drop range for greater production. Hydraulic control system provides hand control for bulldozer and/or ripper, foot control for tilt cylinder on D6.



D6 Integral Hydraulic System
No. 105 Hydraulic Control for bulldozer
54 GPM Pump—1000 PSI
No. 143 Hydraulic Control for No. 6 Tool Bar
29 GPM Pump—1700 PSI



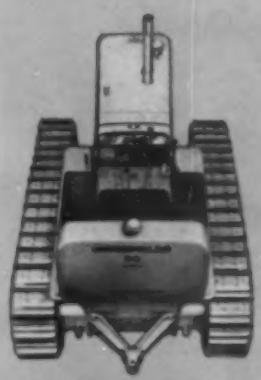
D4 Integral Hydraulic System
No. 143 Hydraulic Control with:
29 GPM Pump—1700 PSI for bulldozers
17 GPM Pump—1700 PSI for tool bars



D6 operator's compartment

New operator convenience and comfort in co-ordinated compartments

The cockpits are all new. Controls are co-ordinated to make one motion flow into the next, reducing hand movements and speeding every operation. Forward-reverse lever (new on the D4) is next to the operator's right hand to speed 'dozer cycle times. Short-travel transmission speed selector shifts gears easily, quickly. Boosters for steering clutches save muscles . . . increase efficiency.



D4 operator's compartment

New D4 Series C and D6 Series B Tractors

hydraulic track adjusters, lifetime lubricated track rollers, the oil clutch, the forward-reverse lever. Your Caterpillar Dealer will be happy to give you the complete facts about both the new D6 and the new D4 and demonstrate them on any of your jobs. The tougher, the better.

Caterpillar Tractor Co., General Offices, Peoria, Illinois, U. S. A.

CATERPILLAR

Caterpillar and Cat are Registered Trademarks of Caterpillar Tractor Co.

BORN OF RESEARCH
PROVED IN THE FIELD

American-Made

CAST IRON PRESSURE PIPE

Backed by Strong, Dependable, Responsible Companies

Cast Iron Pressure Pipe produced in America today is backed by responsible companies with long established reputations for quality products ...for proved integrity and dependable supporting service.

These priceless intangibles are added guarantees of the long-lived performance and long term economy of *American-made* Cast Iron Pressure Pipe.

No such guarantees are available to buyers of so-called "bargain" foreign pipe, whether cast iron or cheaper substitutes. If foreign pipe fails, it's the buyer's loss.

–and finally, remember–what America makes, makes America!
Buy pipe that helps create prosperity over here.

1816 MONTREAL, CANADA — 10" Water Main

1828 LYNCHBURG, VA. 7" Water Main

1830 PHILADELPHIA, PA — 6" Water Main

1834 READING, PA. — 4" Water Main

1831 RICHMOND, VA 8" Water Main

Early Cast Iron Pressure Pipe, like this, has been in service for a century or more in 68 American cities. Today's American-made Cast Iron Pipe is even better because of improved manufacturing methods, production standards and rigid metallurgical and laboratory controls. You can buy it with confidence in the efficiency of its service and the integrity of its makers.

This advertisement is published in the interests of the Cast Iron Pressure Pipe Industry by.....

WOODWARD IRON COMPANY

Since 1882

WOODWARD, ALABAMA

Series HLE

Revolving Aerial Ladders

WITH ELECTRIC-POWERED HYDRAULIC ELEVATION

Safe, easy operation of the HLE Ladder inspires confidence . . . enabling the user to work comfortably and thereby complete more overhead jobs every day.

Equally important, simplified design of the ladder reduces initial cost as well as installation and maintenance expense—to a minimum that fits any operating budget.

Elevation, controlled from ladder base or working platform, is actuated by a hydraulic cylinder powered by an electric motor-driven pump. Motor is powered by the truck battery . . . with no appreciable effect on battery life. Manual extension and rotation is fast and easy. From horizontal to nearly-vertical elevation, at any length and at any point in a 360-degree rotating arc, the ladder locks in position to which it is moved.

Literature containing complete construction and operation details on 27′, 31′, 35′ and 40′ Series HLE Ladders is yours—with price information—for the asking.

Another reason why
UTILITIES EXPECT MORE FROM

POWERS American

UTILITY BODIES AND EQUIPMENT

SERIES 5510

The range and ease of operation of this manually-operated unit, coupled with its safety, durability and trouble-free service, has made it a favorite with utility users everywhere.

Available in ground-to-platform heights of 23½′, 26½′ and 30½′ for installation on a body that fits your exact requirements.

SERIES HL

Fully-powered elevation, extension and rotation puts the Series HL Ladder in a class by itself when it comes to saving time on overhead jobs. Safe, efficient, durable . . . in heights of 27′, 31′, 35′ and 40′. Can be furnished on a body designed to fit your specific job needs.

For descriptive literature and prices write . . .

McCABE-POWERS BODY COMPANY

5900 NO. BROADWAY • ST. LOUIS 15, MO.

625 Cedar St. • Berkeley 10, Calif.
1401 E. Washington Blvd. • Los Angeles 21, Calif.
5525 S. E. 28th Ave. • Portland 2, Ore.

CLOW

Quick, Bottle-Tight Seal

Large, thick section gasket of long-life high durometer rubber forms pressure-tight seal.

Bell-Tite Joint Pipe available in diameters from 3" thru 24" in 18 foot lengths.

Patented Bell-Tite Joint.
Patent No. 2898131

This yellow stripe, when no longer visible, provides visual proof that joint is completely and correctly assembled.

Underwriters' Laboratories, Inc. Listed for working pressures up to 350 psi.

Ample deflection to meet casual curves or grades is provided by space in socket of the bell.

CLOW CAST IRON PIPE

Cast Iron Pipe Plants at

BENSENVILLE, ILLINOIS • BIRMINGHAM, ALABAMA • COSHOCTON, OHIO

CAST IRON PIPE

You can install

CLOW BELL-TITE® JOINT PIPE

as fast as you can dig a shallow trench

Pictures show CLOW 20" Bell-Tite Joint Cast Iron Pipe being installed to provide water for a midwestern industrial development. CLOW Bell-Tite Joint Cast Iron Pipe was selected because of its proved long life and the ease and speed of installation. Hulett Corporation, contractors.

LOWER
pipe into trench

SWING
into open bell

SEAL for
pressure-tight
joint

JAMES B. CLOW & SONS, INC.
201-299 North Talman Avenue, Chicago 80, Illinois

Subsidiaries:
Eddy Valve Company
Waterford, N.Y.

Iowa Valve Company
Oskaloosa, Iowa

Equipment and Materials for your PUBLIC WORKS PROGRAM

The engineering information in these helpful catalogs will aid you in your Engineering and Public Works programs. Just circle numbers you want on the reply card, sign and mail. This free Readers' Service is restricted to those actively engaged in the public works field of cities, counties or states.

NEW LISTINGS

To Keep You Up-to-Date . . .

22. On tractor loaders, motor graders and tractor shovels, Allis-Chalmers keeps bringing out new literature that is well worth your while. Ask them for it, specifying where your interest lies. Write Allis-Chalmers Mfg. Co., Tractor Group, Box 512, Milwaukee 1, Wis. or circle our card.

Much Cheaper than Cops . . .

31. is good street lighting in preventing crime. To guide you to better lighting there is a new Kerrigan booklet, "A Bright City is a Safe City." Describes full line of lighting standards, also how to promote better lighting in your city and county. Address, Lighting Standard Div., Kerrigan Iron Works Co., 1033 Herman St., Nashville, Tenn. or use our card.

Find Polaris Much Faster . . .

55. With the help of the new Gurley 1960 Ephemeris, just out. Surveyors, instructors and engineers will welcome this free book showing Northern, Southern and Equatorial stars, keyed to the tables in this Ephemeris. Just write for it, to W. & L. E. Gurley, 514 Fulton St., Troy, N. Y. or use our card.

Eats Stumps Alive!

61. A radically new type of stump removal equipment is the "Stump Gobbler" just put on the market to offer claimed savings of more than 60% on initial purchase cost. Self-powered, versatile, able to go down to unlimited depths in complete stump removal. Hooks up quickly to your tractor. Write Myers-Sherman Co., Streator, Ill., or circle on the card.

Steel and Aluminum Lighting Poles for Streets and Highways

74. Standard designs, assembly details, suggested pole sizes and base construction details are some of the information offered in Bulletin LS-29 (Steel) and Bulletin LS-30 (Aluminum). Check the reply card or write The Union Metal Mfg. Co., 1432 Maple Ave., NE., Canton 5, Ohio, for details covering the latest Monotube pole designs for modern streets and highways.

Many New Construction Techniques . . .

35. are now possible through use of new Sika epoxy compounds for bonding, patching, joint and crack sealants, and coatings for concrete, and for resurfacing or pavements. Get new bulletin SEC 759 from Sika Chemical Corp., 35 Gregory Ave., Passaic, N. J. or use our card.

Don't Stand There Figuring!

51. Use the new Forney PSI Calculator "slide rule" for concrete products that includes instant conversion data from total load to psi on 17 standard test specimens and masonry units. Pocket size. Free. Address Forney's Inc., Tester Div., Box 310, New Castle, Pa.

Chews Up Coarse Sewage Screenings, Bulk Garbage and What-Have-You.

72. 10 years' experience in battling wet, tough sticky materials as above to get them in shape for easier handling goes into design and manufacture of these Master Crushers. You will find their booklet both interesting and informative. To get it write Ray-Mo Mfg. Co., Verdon, Neb., or circle number on our card.

MORE LISTINGS ON PAGES 36 TO 52

Precision in Chemical Feeding . . .

85. is the big element in solution feeding for water works plants and swimming pools. Applications include feeding of hypochlorites, soda and soda ash for pH control, fluorides and corrosion inhibitors. Get literature from Precision Chemical Pump Corp., 1396 Main St., Waltham 54, Mass., or circle the number on our card.

Care and Feeding of Home Swimming Pools . . .

87. Has become a live subject with thousands. Now here is a new and valuable booklet that answers all their owners' questions about how to keep the water clean, clear and safe. For yours, write Olin Mathieson Chemical Corp., Industrial Chemicals Division, Mathieson Bldg., Baltimore 3, Md., or circle this number on our card.

Complete Package for Chemical Feeding

89. Pump-Tank combination ends a lot of old headaches, saves space and money, too. Comes ready to connect. Two-page bulletin 1800.20-1 tells all about this Proportioneers unit to simplify your chemical feeding. Address B-I-F Industries, Inc., 345 Harris Ave., Providence 1, R. I.

A New Valve for Zeolite Softeners

91. Monotrol, single control valve for softeners, ion exchange units and filters is subject of Bulletin WC-122 discussing operation, design and construction details. Ask for it direct from Graver Water Conditioning Co., 216 W. 14th St., New York 11, or use our card.

Rust is a Loss; Lick it with Rust-Oleum

92. Here is a new 1960 catalog, filled with new facts on how to defeat ravages of rust, protect every metal, and beautify it too. Catalog is a work of art in full color. For your copy write for Form No. 259 to Rust-Oleum Corp., 2799 Oakton St., Evanston, Ill.

Beats Shoveling or Lifting

93. Here is a way to save labor for handling wet or dry flowable bulk materials such as lime and chemicals in your treatment plants. New brochure describing Hapman Hi-Lift "Cable-Veyor" to be had by addressing Conveyor Div., Hapman Corp., 630 Gibson St., Kalamazoo 6, Mich., or circling our card-number.

Make Molehills out of Your Refuse Mountains

94. New and better ways of refuse and garbage collection and handling are described in newest literature on collection systems employing giant containers, bodies and trailers that speed your work, cut costs, improve sanitation. Adaptable to small cities as well as large. Write Dempster Brothers, Dept. PW, Knoxville 17, Tenn., or circle the number on our card.

Bores in Every Direction

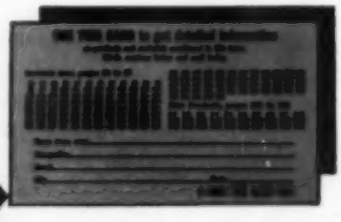
98. That's the Ka-Mo tool that laughs at clay, frozen ground, shale, lime rock when drilling through them, horizontally, vertically or at an angle. Air, hydraulic, electric and gasoline powered. New 12-page booklet includes every detail you need for deciding on drills for your sewer, water and highway work. Address Ka-Mo Tools Dept., Kwik-Mix Co., 235 West Grand Ave., Port Washington, Wis.

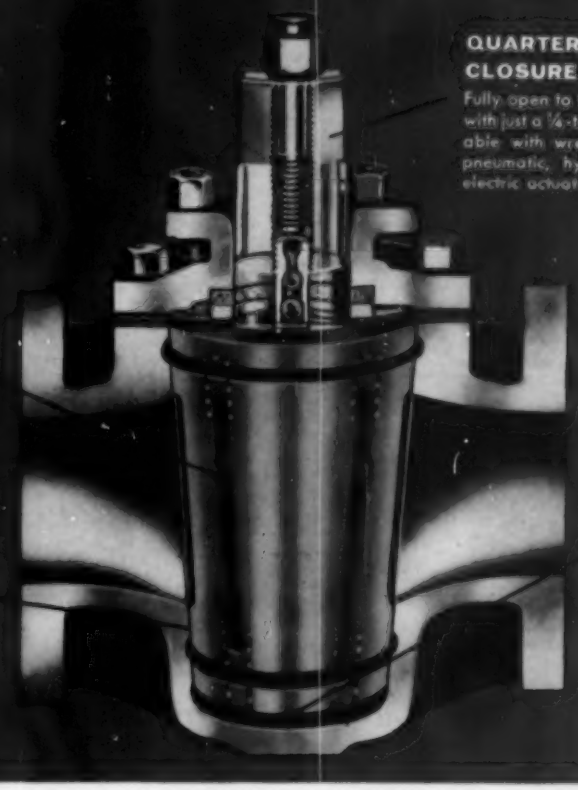
400 Tons an Hour With Only 64 Hp . . .

100. That's just one report on the Koehring "Skooper" which is combining the full-revolving swing of a shovel with the big bucket capacity and versatility of a tractor loader, giving a new concept in speed loading. Cuts costs at every turn. Address Koehring Div., 3026 W. Concordia, Milwaukee 16, Wis. or circle the number on card.

Before Taking Bids on Water Storage Tanks . . .

104. Learn more about GATX tanks, designed and fabricated by one of the nation's largest steel fabricators in accordance with AWWA specifications and municipal requirements. For detailed information, address Plate and Welding Div., General American Transportation Co., 135 So. La Salle St., Chicago 90, Ill., or circle our card number.





QUARTER-TURN CLOSURE
Fully open to fully closed with just a ¼-turn—Available with wrench, gear, pneumatic, hydraulic or electric actuators.

SEALS PERFECTLY
Tapered plug gives maximum strength, positive seating. No up-stream or down-stream "side."

PROTECTED SEATS
Seats are never exposed to the line—Rotary action "wipes" the plug clean.

CAN'T STICK
Plug is lubricated for easy, positive operation.

WHY IS A LUBRICATED PLUG VALVE BEST FOR WATER AND SEWAGE SERVICES?

In a wide range of water and sewage services, Rockwell-Nordstrom lubricated plug valves are giving trouble-free flow control at lowest cost. Just a few of the valve's advantages are shown in the drawing above. One of the most important basic advantages is *pressurized* lubrication which hydraulically seals against leakage and frees the tapered plug for instant operation. Lubricant also makes the quarter-turn operation smooth and easy and saves money by stopping metal-to-metal wearing friction. See how these valves can help you to do your job better, and at lower cost. Get the precise size and pressure rating you need, too. Sizes from ½" to 36"; pressure ratings to meet your needs. Send the coupon today for more information on Rockwell-Nordstrom's complete line of lubricated plug valves and operating accessories. Rockwell Manufacturing Company, Pittsburgh 8, Pa.

ROCKWELL-Nordstrom VALVES
another fine product by
ROCKWELL

Rockwell Manufacturing Company
Department 497WSB
Pittsburgh 8, Pennsylvania

Please send me Bulletin C-5200.

Please have your sales engineer call.

Name _____ Title _____

Address _____

City _____ Zone _____ State _____

To order these helpful booklets check the reply card opposite page 34.

NEW LISTINGS (Cont.)

Stop and Go . . .

103. to your desk to write about these new traffic controllers for isolated intersections. Does an efficient job where multi-purpose control systems are not required. Quite likely you have long sought this. Described in new Bulletin 2720, to be had from Crouse-Hinds Co., Wolf & N. Seventh Streets, Syracuse 1, N. Y.

Don't Send a Man to do a Boy's Work

108. Look into the SJ Maintenance distributor designed specifically for paving jobs where using bigger equipment would be impractical and uneconomical. Yet the SJ can be diverted to projects as big as construction of secondary roads. Why not find out about it by writing Standard Steel Works, North Kansas City, Mo., or just circle number on the card.

Get the Real Story on Plastic Pipe

116. Available at last in new 36 page handbook for engineers, filled with pertinent information on the use of KRALOY PVC plastic pipe, fittings and valves, with a wealth of collateral data that you will welcome. To get it free, address Kraloy Plastic Pipe Co., 4720 East Washington Blvd., Los Angeles 22, Calif., or use our card herein.

Two New Tractor Shovels

117. To deliver maximum production combined with fast, economical operation two new models have been announced. Each has three interchangeable buckets and the famous Trojan Safety Curve Lift Arms. Ask for specification bulletins from The Yale & Towne Mfg. Co., Trojan Div., Batavia, N. Y., or circle their number on the card.

Got to do Asphalt Mixing or Patching?

118. Whatever the job, speed and simplify your work with modern Wylie equipment for hot or cold paving materials. As the first step to improved performance get new data from Wylie Mfg. Co., 5926 N.W. 39th St., Oklahoma City 12, Okla., or use the reply card.

Keep Sewage Testing Simple

106. By using the Fisher-Hatfield Sewage Testing Unit. The Fisher "packaged labs" for small plants are available according to your needs, from populations under 7500 to over 25000. Contain everything from BOD incubators to red pencils. 16-page booklet describes them. You write Fisher Scientific Co., 717 Fisher Bldg., Pittsburgh 19, Pa., or circle our card-number.

Increase Your Refuse Collection Efficiency by 20 Percent

123. New principles and features like continuous loading, pre-crushing of refuse, bigger collections per load, safer operation, lower maintenance, faster collections are all described in new Catalog Section 5a. Write for it to Daybrook Hydraulic Div., Bowling Green, Ohio, or—easier—just circle our card-number.

Brush-on Permanence . . .

128. With this quality liquid plastic that pays for itself in 80 percent saving on maintenance. Not a paint but a protection that stops rust on metal, rot in wood, resists acids and weather, can't peel, chip or crack. Beautifies, too. Clear or colors. Literature describes uses. Write Sav-Cote Chemical Labs., Box 2128, Alexandria, Va., or circle our card.

Eats 'Em Alive

136. Whether your materials reduction problem is concerned with refuse, garbage, tree branches, old tires, or what not, there's an M & M Hog that can chew it up into easily handleable shape. Catalog H 854 tells all about it. For yours write Mitts & Merrill Co., 1009 So. Water St., Saginaw, Mich., or just circle the number on card.

"Huge Haul" for Huge Hauls

145. Describes the Load Lugger system utilizing various-sized detachable containers in capacities of from 40 cu. yds. to 30,000 lb. net payloads. One-man operated. Specially offered to cities, counties, contractors for refuse collection, handling and disposal. For Bulletin 457 address Load Lugger, Ingersoll Kalamazoo Div., 1810 No. Pitcher, Kalamazoo, Mich., or circle number on our card.

"Quick-Way" has News for You

125. Get the story on their new truck cranes and shovels, 8½ ton and up, that offer a rating to fit your job at a cost to fit your budget. For the full details, write "Quick-Way" Truck Shovel Co., P.O. Box 1800, Denver 5, Colo., or circle number on our card.

For Holidays that are Not Fun

127. Holidays on pipe coatings, that is, find out what these Holiday Detectors can do to spot actual or potential trouble in buried pipe. Surprisingly simple and efficient. Get the full facts by writing for literature, to Tinker & Rasor, Box 281, San Gabriel, Calif., or circle our card-number for us to get it for you.

When You Need Water Stops

129. Have all the facts as contained in free 43-page book MRG 622 of the Gates Rubber Co., 999 So. Broadway, Denver, Colo. Ask them for it, or we will get it for you if you circle their number on card herein.

Brass Goods for the Water Works of America

130. The McDonald line goes all the way from curb stops to gooseneeks, corporation stops, couplings—everything pertaining to service connections. Catalog B 100 and PB 69 with much valuable data available from A. Y. McDonald Mfg. Co., 12th & Pine St., Dubuque, Iowa.

The Submersible Pump You have Been Waiting For

141. Electric, fully submersible, portable, runs dry without damage, no priming, and other outstanding advantages. All are described in Flyght Bulletin B-802 of Stenberg Mfg. Corp., Hoosick Falls, N. Y. Address them or just circle the number on our card.

Please Pass the Salt

148. What it can do for you in snow and ice removal is the title of a new 24-page booklet explaining salt's properties as a de-icing chemical and how best to use it economically. Address Salt Institute, 33 North La Salle St., Chicago 2, Ill., or circle the number on our card.

McDONALD'S 104 YEARS OF EXPERIENCE STAND BEHIND THIS PRODUCT

McDonald 4701 Corporation Stop—Standard A.W.W.A. thread for copper service pipe. Sizes from ½ inch to 2 inches. A catalog of McDonald's complete line of brass goods is available on request.

A. Y. McDONALD MFG. CO., Dept. PW-260, 12th & Pine, DUBUQUE, IOWA • Brass Goods • Pumps • Oil Equipment • Drains

does work of crew with 4-in-1 BUCKET

The Town of Gates, N. Y. is a thriving, progressive community, with 60 miles of roads, 42 of which are well maintained by the Gates Highway Department. When the time came to replace its tractor-shovel, a "PAYLOADER" equipped with a Drott 4-in-1 bucket was selected. It is used for new construction, general maintenance, snow removal, right-of-way clean-up, stockpile handling and scores of other jobs the year around.

"AN ALL PURPOSE MACHINE"

George Biesenbach, Highway Supt. is really enthusiastic about his winning combination, reporting that, "It is an all-purpose machine that saves us time and labor in nearly all our work. On-the-job experience is proving that our PAYLOADER with Drott 4-in-1 bucket and a single operator can do many jobs alone which used to take extra labor with a regular tractor-loader. We really like the PAYLOADER because of its unmatched versatility and because it does our jobs better, faster and more economically."

A "PAYLOADER" with 4-in-1 will also give you job versatility you've never before experienced . . . use it as a bulldozer, as a scraper, a clamshell or as a standard excavating-loading bucket. Find out what it will do for you. Return the coupon or see your Hough Distributor, today.

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Please send data on complete "PAYLOADER" line and attachments.

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Govt. Unit.....

Street.....

City.....State.....

2-8-3

To order these helpful booklets check the reply card opposite page 34.

NEW LISTINGS (Cont.)

Weeds Controlled by Using Simazine 50W

131. General weed control is accomplished by using Simazine 50W and water. For full information on this new pre-emergence herbicide and how to use it write Geigy Agricultural Chemicals, P. O. Box 430, Yonkers, New York.

Modern Methods and Materials For Jointing Sewer Pipe

158. In a compilation of reprints and related supplementary material, the Atlas Mineral Products Co., Mertztown, Pa., presents a comprehensive review of all types of sewer jointing materials and methods. You will find this interesting and informative reading.

Stationary Diesels For Water and Sewage Plants

147. Engines are four-cycle, 6 or 8 cylinder, in-line models, ranging from 530 to 2,000 bhp and from 300 to 1,250 KW, are available either naturally aspirated or supercharged, and can be furnished to run as diesel, dual-fuel or gas engines. For Bulletin #110 check the reply card or write White Diesel Engine Div., The White Motor Co., Springfield, Ohio.

Hydraulic Backhoe For Many Makes of Tractors

168. A backhoe that digs sewer systems, culverts, water mains, foundations and ditches is described fully in literature from Henry Mfg. Co., Inc., 1700 N. Clay St., Topeka, Kans. Check the reply card for specifications and details.

Good News for Trench Fillers and Road Wideners

171. Is contained in the literature on this versatile conveyor. Saves you money by speeding up operations, quick attachment and detachment on trucks. Handles earth, sand, cinders gravel. One operator does wonders with it. Address Power-Pack Conveyor Co., 836 E. 140th St., Cleveland 10, Ohio, or circle our card-number.

Compact Wheel Tractor Makes Maintenance Jobs Easy

172. Rugged and powerful yet exceedingly low in cost, the Speedex Model S23 tractor with 9 hp engine will work for you all year around on park and yard maintenance chores. Attachments include gang and rotary mowers, cutter bar, front and rear blades. Check advantages of this versatile machine by writing Speedex Tractor Co., 367 N. Freedom St., Ravena, Ohio, or check the card.

Why Hunt All Over the Place?

201. Instead, use this 32 page cross-indexed catalog for quick easy reference equipment, trade names and applications. Covers all major equipment in the complete Infilco line. Write for Bulletin 80 to Infilco Inc., P.O. Box 5033, Tucson, Arizona.

Here's a New Note in Filter Cleaning Equipment

202. Just announced, a new S-Type Filter Arm that is reported to increase filter cleaning efficiency by 25 to 30%. Doubles the agitating impulses and improves your plant performance strikingly. Adaptable to present installations, too. Write Palmer Filter Equipment Co., Erie, Pa., or circle our card.

Your Citizens Might Ask Embarrassing Questions

203. About why you were caught with your power down during interruptions to your regular supply. How to be safe in dangerous emergencies like that is the theme of literature offered by these makers of diesel electric power plants on wheels, ready to take over on arrival. Write A.G. Schoonmaker Co., Sausalito, Calif., or circle our card number.

U. S. Tyton Joint Pipe

210. An eight page booklet on centrifugally cast, Tyton Joint® pipe for water or other liquids is available. Tyton Joint cast iron pipe is provided with a simple, sturdy and tight slip-on type of joint. Illustrations show details of joint and method of assembly. Write U. S. Pipe & Foundry Co., Birmingham 2, Ala., or check the reply card.

WATER WORKS

In-Place Cement Lining of Small and Large Pipe

25. A catalog describing a process of in-place centrifugal cement lining of pipes from 4 to 144 ins. in diameter is available from the Centriline Corp., Raymond International Inc., 140 Cedar St., New York 6, N. Y. Check the reply card for sample specifications and test results.

Wherever Water Flows, Steel Pipes It Best

26. Complete data on the use of steel pipe for water supplies are available from Steel Plate Fabricators Association, 105 West Madison St., Chicago 2, Ill. Check the reply card today.

Elevated Tanks and Other Storage Facilities

32. Specification sheet covering elevated tank sizes and design and illustrated brochure available from the Darby Corp., Kansas City 15, Kansas.

Easily Cleaned Long Run Filter Bed Media

70. Bulletins on Anthrafilt tell the reasons why selected, graded crushed anthracite is superior to sand as a filtering material. Have you made a full investigation? Write Anthracite Equipment Corp., Wilkes-Barre, Pa.

Rapid Sand and Pressure Filter Data

109. Rapid sand filters. A complete line of vertical and horizontal pressure filters, wooden gravity filters, and filter tables and other equipment. For engineering data, write Roberts Filter Manufacturing Co., 640 Columbia Ave., Darby, Pa., or check the reply card.

SPEED SENSITIVE SWITCHES

All GH series of cable driven governors and switches are available in this GH-E series. This housing meets the specifications for class 1 group D, Explosion Proof Equipment. For further information, write for Bulletin 504-A.

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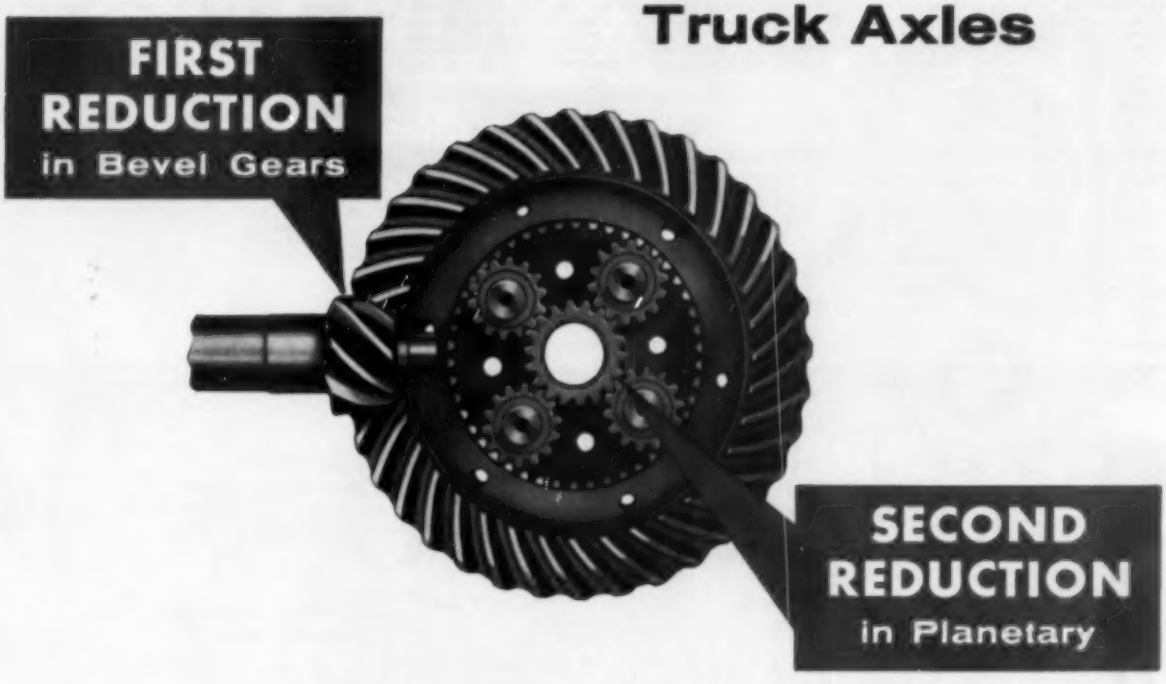

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Save Weight—Size for size, Eaton PDR Axles weigh less than conventional herringbone or spur gear axles, permit truckers to haul more legal payload.

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To order these helpful booklets check the reply card opposite page 34.

Handbook of Cast Iron Pipes and Fittings

52. Full engineering data on products of the Alabama Pipe Co., including Super De-Lavaud cast iron pressure pipe and pipe fittings, valve boxes and other municipal castings are provided in Pressure Pipe Catalog No. 54, a 196-page publication of Alabama Pipe Co., Anniston, Ala. Weights, dimensions and specifications are clearly indicated in this easy to use in reference.

Convenient Reference Manual Covers Cast Iron Pipe, Valves and Hydrants

74. An 80-page manual, issued by R. D. Wood Co. Independence Sq., Philadelphia 5, Pa., presents specifications for "Sand-Spun" cast iron pipe and fittings, outlines types of joints available, lists dimensions and weights in convenient tables and includes, in addition, full engineering data on the Mathews and R. D. Wood fire hydrant and R. D. Wood gate valves.

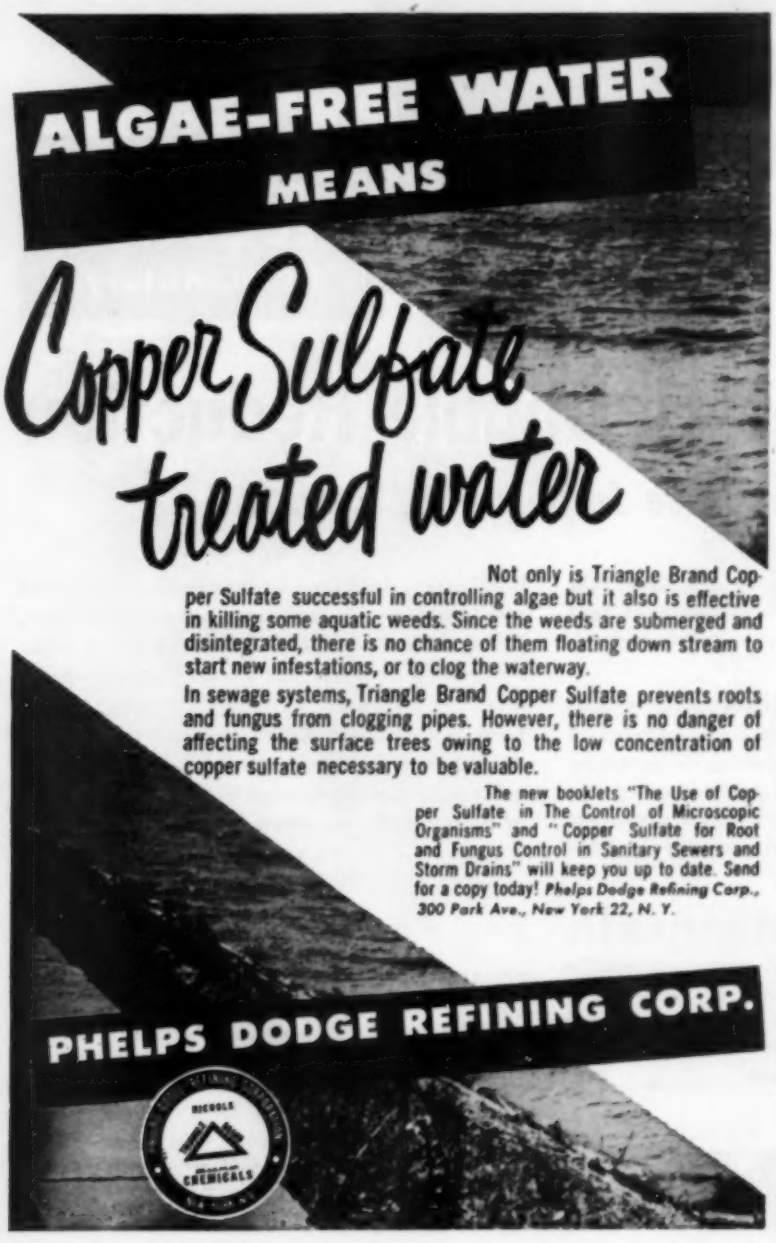
Ball and Socket River Crossing Cast Iron Pipe

33. Literature is available describing Clow ball and socket cast iron pipe for river crossing, or any installation where full 15 degree free turning deflection is desirable. For description and specifications, address James B. Clow & Sons, Inc., P. O. Box 6600-A, Chicago 80, Ill.

Use The Reply Card

Right Angle Gear Drive and Deep Well Turbine Pump

187. Applications, gear drive selection tables, pulley data, efficiencies and standard dimensions of Johnson right angle gear driven are covered in catalog from Johnson Gear & Mfg. Co., Ltd., Eighth and Parker Sts., Berkeley 10, Calif. Check the reply card.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The new booklets "The Use of Copper Sulfate in The Control of Microscopic Organisms" and "Copper Sulfate for Root and Fungus Control in Sanitary Sewers and Storm Drains" will keep you up to date. Send for a copy today! Phelps Dodge Refining Corp., 300 Park Ave., New York 22, N. Y.
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Information on Service, Valve, Roadway and Meter Boxes

122. Literature on specifications covering "Buffalo" service, valve, roadway and meter boxes, and adjustable valve boxes for water and gas has just been released from Buffalo Pipe & Foundry Corp, Box 33-Station B, Buffalo 7, N. Y. Check the reply card for your information on these valve boxes.

Fluidics—The Science of Fluid Processes

140. Applications of Fluidics range from reactions to storage, from water treatment to waste treatment and from design and development to project engineering. The specific areas of use are covered in detail and each section is illustrated with application photos and concise engineering data in bulletin. Check the reply card or write Permutit Co., Div. of Pfaudler Permutit Inc., 50 W. 44th St., New York 36, N. Y., for Bulletin 980.

AWWA Fire Hydrants and Gate Valves

155. Above-ground maintenance Mueller AWWA improved fire hydrants and minimum maintenance Mueller AWWA non-rising stem gate valves are described in literature from Mueller Co., Decatur, Ill.

Valve and Hydrant Construction Details

161. A 72-page catalog-type bulletin, just completed, gives detailed data on construction and application of gate valves, check valves and hydrants for water works service. Write for Bulletin 5710 from Darling Valve and Mfg. Co., Williamsport, Pa., or check the reply card.

Design of Prestressed Concrete Tanks

194. An 8-page technical Bulletin, T-19, on the Design of Prestressed Concrete Tanks, gives engineering data and formulas of general interest to anyone considering prestressed concrete for storage tanks. Check the reply card or write The Preload Co., Inc., 21 East 37th St., New York 16, N. Y.

Complete Catalog and Reference Data on Valves and Fittings

211. The entire M & H line of valves, fittings and accessories for water works, filtration, sewage disposal and fire protection are illustrated and fully detailed in Catalog 52 issued by M & H Valve & Fittings Co., Anniston, Ala. In addition to complete data on these products, there are many pages devoted to helpful engineering data. Every designer should have a copy.

Waterworks and Municipal Castings

293. Meter boxes and covers, yokes and couplings, service boxes and manhole covers are covered in 24-page catalog. Check the reply card or write H. W. Clark Co., Mattoon, Ill., for full specifications.

Manual on the Hersey Disc Water Meter

329. Illustrations, descriptions and specifications of Hersey water meters are covered in manual available from Hersey-Sparling Meter Company, 250 Elm St., Dedham, Mass. Size ranges are ⅝"-⅝"x¾"-¾" and 1". Check the reply card.

Tips for Installing Orangeburg Pipe

336. Good practice for installation of Orangeburg pipe and fittings is outlined in an illustrated four-page bulletin made available by the Orangeburg Mfg. Co., Inc., 375 Park Avenue, New York 22, N. Y. Trenching and backfilling, pipe laying, cutting and connecting with other types of pipe are included.

Testing Water Meters

383. This 40-page catalog is a discussion of fundamentals and a guide to sound practice in meter maintenance. It covers standard specifications of meter accuracy, descriptions of the latest developments in meter testing equipment and many drawings and diagrams. For your copy write The Ford Meter Box Co., Inc., Wabash, Indiana, or check the reply card.

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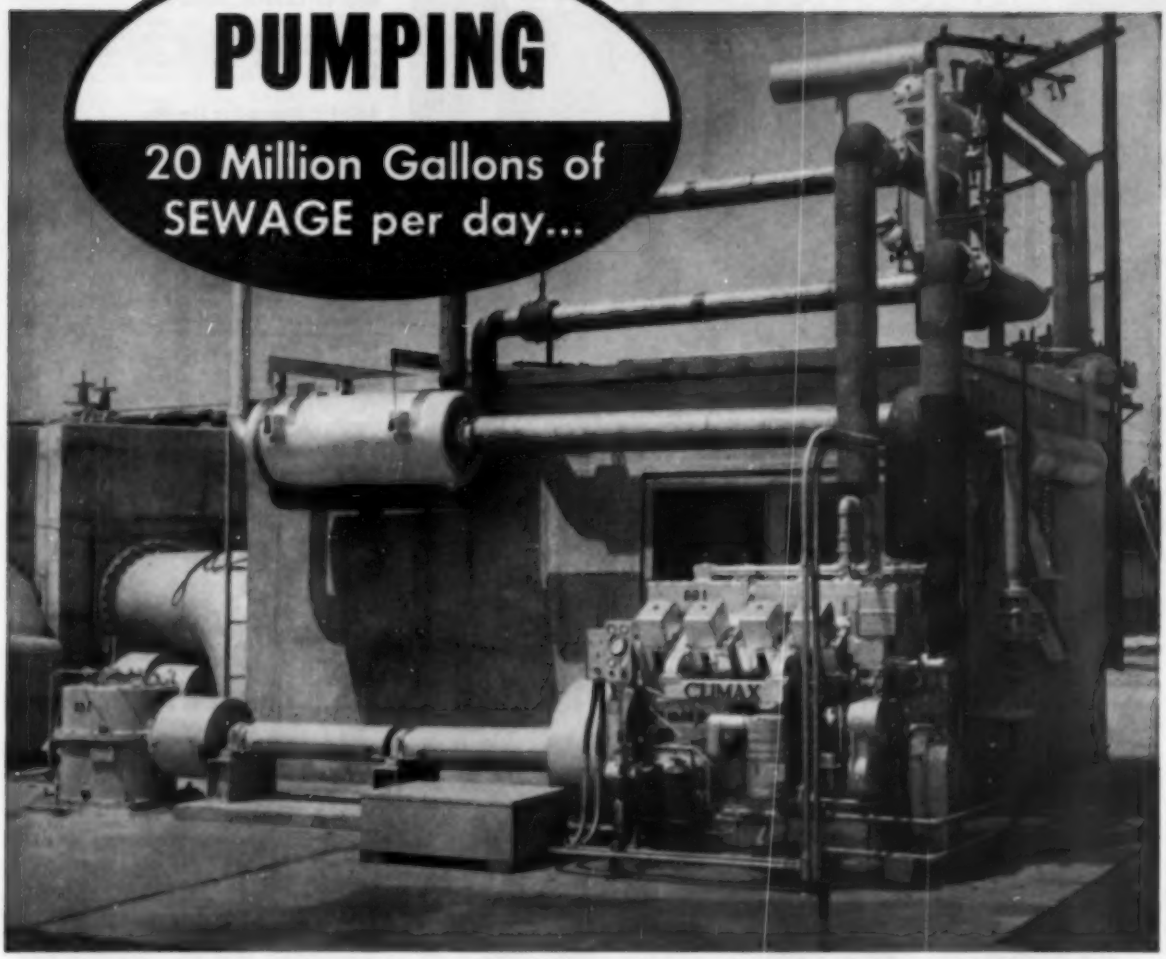

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two CLIMAX V-85 ENGINES *power the pumps*

Driving centrifugal pumps, two Climax V-85 Engines running at 775 rpm, pump approximately 20 million gallons of sewage per day in Plant No. 1 of the County Sanitation Districts of Orange County, Calif., at Ellis and Verano Streets, Santa Ana. These V-85 Climax Engines —8-cyl., 7½-in. bore x 7-in. stroke, 2474 cu. in. displacement—are burning sludge gas from the digesters; when this gas is not available the engines are automatically switched over to butane fuel. They operate with vapor phase cooling, and the waste heat is used in the digesters. The Climax V-8, unusually compact in design, packs more power into less space. Rugged, too, for durability with dependability in continuous duty sewage plant service. Its famous fuel economy is built-in. For all its plus-value features in detail, get Bulletin SA-584.

CL-109

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Neat – Safe – Permanent
This cast-iron plug screws into brass insert . . . cannot be twisted or broken off.
Sliding adjustment prevents frost from disturbing base and curb cock.
Steel extension rod with welded joints—available with all types of boxes.
STYLE A—Clark Service Box for use with iron pipe.
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STYLE M—for use with Minneapolis Type Curb Stops.
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H. W. CLARK CO.
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Book Tells
How to Control Algae

371. Details on the control of various microscopic organisms frequently found in water supplies are furnished in a 44-page booklet offered by Phelps Dodge Refining Co., 300 Park Ave., New York 22, N. Y. Check the reply card.

385-HP Engine For Standby
Pumps and Generator Sets

372. International 385-hp compact heavy-duty 4-cycle, 6-cylinder engine is well illustrated in literature from International Construction Equipment, International Harvester Co., 180 North Michigan Ave., Chicago 1, Ill. Check the reply card for full specifications.

Modern Elevated
Water Tanks

566. A 16-page bulletin describing 2 types of water storage tanks, the watersphere and the watersphereoid, is available from the Chicago Bridge & Iron Co., 332 South Michigan Ave., Chicago 4, Ill. Standard sizes from 25,000 gals. to 500,000 gals. are covered.

Play Safe
with Automatic Controls

603. Remote engine and pumping controls of every sort are fully described in a series of bulletins offered by Synchro-Start Products Inc., 8151 N. Ridgeway Ave., Skokie, Ill. Write them or circle the above number on our card.

This Metering Pump Can't
Cook . . .

613. but you will find it complete with features for water service. Heavy duty design, capacities from 0.65 to 2025 gph. Utter accuracy, corrosion-resistant, versatile. Series 200 is its identification. Write Wallace & Tiernan Inc., Belleville 9, N. J., for new fact-filled brochure. Or circle our number on card.

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Air Control Valves For
All Types of Pipelines

620. Literature on Crispin Air Valves, which safely control air in lines handling liquids, to maintain efficient operation and prevent expensive failures, is available from Multiplex Manufacturing Company, Dept. C, Berwick, Pa. Write today for your copy of the Crispin Air Valve Catalog, which offers complete information on the full line of dependable Crispin Air Valves.

Water Service Hydrants
and Outdoor Drinking Fountains

661. Water service hydrants in 4 sizes, ¾", 1", 1¼" and 2" and all types of outdoor drinking fountains are described in a well-illustrated, 24-page catalog from The Murdock Mfg. & Supply Co., 426-30 Plum St., Cincinnati 2, O.

Electronic Locators for Water
Mains, Services, Valves and Boxes

677. Miniaturized line locator that is encased in a molded glass fibre container and has transistors that have a rated life of 70,000 hours and weighs only four lbs. when completely assembled is described in literature from Wilkinson Products Co., 3067 Chevy Chase Drive, Pasadena 3, Calif. Check the reply card.

Bulletin Covers Step-by-Step
Action on the Water Problem

689. A step-by-step outline of action telling how the responsible citizens can help their officials extend and improve the local water system through more adequate rate structures on financing is covered in this bulletin available from Thos. F. Wolfe, Managing Director, Cast Iron Pipe Research Association, 3440 Prudential Plaza, Chicago 1, Illinois.

Water Filtration
Costs Can Be Reduced

692. The "Celite" system of diatomite filtration makes possible reduced installation cost, with space requirements a fraction of those for equivalent sand filtration. For informative literature write Johns-Manville, Box 14, New York 16, N.Y.

To order these helpful booklets check the reply card opposite page 34.

SEWERAGE AND WASTE TREATMENT

What You Should Know About Trickling Filter Underdrains

20. Specifications for vitrified clay under drain blocks conforming to ASTM standards, suggestions for layouts and construction of trickling filter floors, dimensions of standard blocks, channel covers, angles and other fittings are available from the Trickling Filter Floor Institute c/o Editor, Public Works, 200 So. Broad St., Ridgewood, N. J. Check the reply card and we will forward your request.

Equipment For Water, Sewage and Industrial Waste Treatment

36. The complete line of Jeffrey equipment for treatment plants is covered in a 64-page Catalog 952 available from The Jeffrey Mfg. Co., Columbus 16, Ohio. Check the reply card for information on bar and disc type screens, traveling water screens, grinders, grit collectors, garbage grinders, sludge, draw-off valves, chemical feeders, bucket elevators and scum removers to mention some of the equipment.

Entirely New Small Sewage Treatment Plant

40. The Sparjair units are package type plants that range in size from a 50 population equivalent to 5000 and utilize the contact stabilization process to produce a clear, nuisance free effluent. Copies of Bulletin 22-S-94 are available from Walker Process, P. O. Box 266, Aurora, Ill., or check the reply card.

Catalog on Synchronous Motors and Controls

44. A 27-page Catalog B-7292 on synchronous motors and controls is well illustrated and contains motor selector charts, application data, and formulas for calculating power factor. For a copy write Westinghouse Electric Corp., Box 2099, Pittsburgh 30, Pa., or check the reply card.

Helpful Design Data For Sewage Ejectors

81. The application and advantages of pneumatic sewage ejectors are outlined in bulletin S-55 of the Blackburn Smith Mfg. Co., Inc., Hoboken, N. J. Included are piping diagrams for electrode and float switch controls plus dimensions and layouts for single and duplex systems.

Protective Lining for Concrete Pipe and Structures

131. T-Lock Amer-Plate is a tough, long-lasting acid-resistant vinyl sheet lining for concrete pipe and structures which are exposed to corrosive materials. T-shaped ribs pressed in the sheet are embedded in the concrete as it is poured to lock the lining permanently in place. Get full details from Amercoat Corp., South Gate, Calif., or check the reply card for illustrated folder.

Stationary Engines For Sewage and Water Treatment Plants

83. Engines that operate on sewage gas, gasoline, butane or natural gas are described in literature from Climax Engine Mfg. Co., Div. of Waukesha Motor Co., Clinton, Iowa. Check the reply card.

Incinerators for the Disposal of Combustible Wastes

217. Bulletin 179 from the Morse Boulger Inc., New York 17, N. Y. describes fully the basic principles of incineration as to combustion, auxiliary burners, draft and control and elimination of fly ash. Specifications and design of incinerators and hopper doors are included.

Turnkey Sewage Treatment Plant

239. Plants for smaller population areas that are furnished and installed on a turnkey basis are covered in literature from Municipal Service Company, 4625 Roanoke Parkway, Kansas city 12, Missouri. Check the reply card for your key to low cost sewage treatment.

LOW PROFILE...you see
HIGH CLEARANCE...you go!

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Satisfied users of Blackburn-Smith Ejectors everywhere are convinced they've made the best investment in "B-S" efficient, economical, uninterrupted sewage lift service. No pump troubles; no clogging or cleaning; no complex piping; lowest maintenance cost. Single, duplex units. 30 to 500 g.p.m. Discharge heads to 150 ft. The dependably engineered product of 60 years of experience.

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Sewer Design Flow Chart Based on Manning Formula

154. A large-scale, convenient flow chart based on the Manning formula, together with typical examples of use, is available from Johns-Manville, 22 East 40th St., New York 16, N. Y. To get your copy check the reply card or write to the manufacturer and ask for Bulletin TE-94A.

Guide Book Information for Emergency Power

183. This book covers what to do when commercial power fails in a fire, flood, hurricane, war and other national disasters. Check the reply card or write Caterpillar Tractor Co., Engine Div., Peoria, Ill., for a copy of "The Four Horsemen of the Space Age."

A Short Course In Pipe Jointing

169. The story of rubber couplings for clay and concrete pipelines is graphically presented in the booklet "Pipe Enterprise", published by Hamilton Kent Mfg. Co., Kent, Ohio. Detailed description of pipe jointing methods; photos showing jobs where Tylox gaskets met the need for easily assembled permanently tight joints installed under all conditions; and a report on the development, manufacture and outstanding features of the compression type gasket make this booklet valuable to every engineer and contractor. Check the reply card.

Heavy Duty Air Cooled Engines For Many Uses

223. Power and weight specifications, dimensions and uses are fully covered in literature issued by Wisconsin Motors Corp., Milwaukee 46, Wis., on their air-cooled engines. Also available is a service map and a list of their distributors and approved service stations.

Bulletin on Waste Treatment Equipment

289. Equipment covered in Bulletin No. 315-11 includes bar screens, grinders, collectors, skimmers, separators and flocculation equipment. Check the reply card or write Chain Belt Co., Milwaukee 1, Wisc., for this data.

Gravity Sewer Pipe Engineering Classifications

305. A quick method for choosing the most economical class of asbestos-cement sewer pipe to suit each laying condition with handy crushing table based on the Marston formula is available from Keasbey & Mattison Co., Ambler, Penna. Check the reply card.

Centrifugal and Turbine Type Pumps For Water and Sewage Plants

321. Turbine-type pumps, close or flexible couple drive, and end suction centrifugal pumps are described in Catalog M available from Aurora Pump Div., The New York Air Brake Co., 636 Loucks St., Aurora, Ill. Included is a pump selection guide and spigot pipe. Check the reply card.

Link-Belt Has Learned a Lot

334. . . . in the past 24 years about Circuline Sludge Collectors. This knowledge is now yours in book No. 2546, to complete your 2650 Link-Belt Sanitary Engineering Binder and help you to better sedimentation. Write Link-Belt Co., Colmar, Pa., or check the card.

Engineering Data on Gas Safety Equipment

343. P.F.T. Gas Safety Equipment for Controlled Digestion is the subject of an excellent 12-page bulletin issued by Pacific Flush Tank Co., Chicago 13, Ill. Full engineering data on flame traps, pressure releases, waste gas burners and related equipment is provided in convenient form. Requests for this valuable booklet must be made on business letterhead.

Gas and Gasoline Engines Described in Literature

338. Roiline engines (formerly LeRoi), gas and gasoline models are built as bare engines, complete power units, and with components and accessories for special services. Check the reply card or write Waukesha Motor Co., Waukesha, Wisc., for details on the use of these engines in compressor, generator and pumping installations.

Data on Adjustable-Speed Magnetic Drives for Low-Lift Pumps

445. A catalog is available from Electric Machinery Mfg. Co., Minneapolis 13, Minn. that tells all about E-M Vertical Synchronous Motors and Magnetic Drive Units. Engineers check the reply card for information on this equipment for sewage pumps.

Putting Small Sewage Treatment Plants in the "Big Time"

557. Four equipment units that get big plant results in small plant operation are featured in an 8-page booklet "Small Plant Sewage Treatment." Drawings and flow sheets give the details. Write Dorr-Oliver Inc., Stamford, Conn. for Bulletin 6692 or use the reply card.

Small Unit Sewage Treatment For 20 to 5000 People

569. Bulletin 135A describes the Rated-Aeration process, a low cost, odorless, trouble-free sewage treatment process. Check the reply card or write Chicago Pump Co., 622 Diversey Parkway, Chicago 14, Ill.

Equipment For Sewage Disposal Plants

585. Sewage gas meters, gas regulators, lubricated plug valves and water meters are described in Bulletin C-5200-J, available from Rockwell Mfg. Co., Meter and Valve Div., 400 N. Lexington Ave., Pittsburgh 8, Pa. Check the reply card.

A Breakthrough in Vacuum Filtration

622. To bring you up-to-date on the Eimco continuous belt drum filter, this new booklet covers design, application and actual case histories. Sewage plant designing engineers will find it highly useful. Write The Eimco Corp., 634-666 South 4th West St., Salt Lake City 10, Utah, or circle the number on our card.

Application and Design of Prefabricated Pumping Stations

637. This manual is intended for a guide in designing sewage pumping stations and in explaining the use of prefabricated underground sewage pumping stations. Check the reply card or write to Zimmer & Francescon, 1713 Fifteenth Street Place, Moline, Ill., for your copy.

Give a Lift to Your Sewage

638. With the new advanced-design TEX-VIT packaged pump station. Full of new features that make for efficiency in pressure controls, improved air circulation based on superior components. For names of municipal users, and Bulletin PS-60 just address TEX-VIT Supply Co., Manufacturing Division, Mineral Wells, Texas, or circle the number on our card.

Manual on Solving Drainage Problems

645. An 80-page Manual on the problems of drainage and drainage materials is available. Design section includes determining culvert lengths and sizes, run-off calculations, excavation of base and backfilling data. Check the reply card or write Bethlehem Steel Co., Bethlehem, Pa., for the third revision of this valuable book containing new tables for evaluating flow fraction.

Controls For Use in Pumping Stations and Sewage Plants

662. Single and multi-pump sump controls, pressure operated for use in pumping stations and sewage disposal plants are described in literature available from Healy-Ruff Co., Water Level Controls Div., 2255 University Ave., St. Paul 14, Minn. The two principal types of pressure operated sump controls are covered along with general descriptions and features.

Full Line of Sewer Cleaning Equipment

681. Everything for rodding sewers from hand operated equipment to the fully mechanized SewRodeR. Tools for all types of stoppages are operated by Flexicrome Steel Sewer Rods. Featuring the Truck-Loder which dumps sewer deposits directly into truck, a complete range of Bucket Machines is offered. All equipment is described in 48-page Catalog 59-A. Flexible, Inc., 3786 Durango Ave., Los Angeles 34, Calif.

JUST INTRODUCED . . . GOING STRONG!

NEW HYDRAULIC OPERATED HAMMER

Henry engineers pioneer again with a Power Hammer that operates hydraulically! In combination with Henry's Backhoe and Loader, or any similar unit, it speeds up operations . . . cuts delays caused by rock formations, frozen ground, or hard-pan clay. Carry the 85 pound hammer to the job in the shovel bucket . . . attach to the hydraulic system, and it's ready to go to work when you need it!

Henry's Hydraulic Hammer can be used with its own power unit. Small, compact, portable, this Hydraulic Unit can be moved easily from one job to another in the back of a pick-up truck or station wagon.

HENRY Manufacturing Company, Inc.
1700A North Clay, Topeka, Kansas

Please send me complete information on the NEW Henry Hydraulic Hammer.

NAME:_____

ADDRESS:_____

CITY:_____ STATE:_____

TYPE OF BUSINESS:_____

To order these helpful booklets check the reply card opposite page 34.

STREETS AND HIGHWAYS

Bitumuls Paving Handbook Full of Useful Data

22. The latest edition of the Bitumuls Paving Handbook covers a wealth of practical data on paving methods and materials, road and airport paving specifications and construction details, complete tabular data on asphaltic binder applications and aggregate requirements, condensed Asphalt Institute specifications plus data on Laykold compounded asphalts for flooring, tennis courts, protective coatings and waterproofing. You can have a copy by checking the reply card. American Bitumuls & Asphalt Co., 320 Market St., San Francisco 20, Calif.

Foundation Investigation and Pressure Grouting

48. Foundation investigation and pressure grouting and the various miscellaneous services of Sprague & Henwood are described and illustrated in literature from Sprague & Henwood, Inc., Scranton 2, Pa.

Concrete Bridge Details

50. An illustrated 48-page booklet, published by the Portland Cement Association, 33 W. Grand Ave., Chicago 10, Ill., calls attention to good and poor practice in bridge building. It also shows how to improve improper details and open the way for use of higher stresses. Write to PCA for your copy or check the reply card.

Davis Backhoe Has Hydra-Slide Positioning

189. It is possible for one man to move the entire digging assembly along the frame to any of the five positions in less than five minutes. Full details from Massey-Ferguson Industrial Div., 1009 South West St., Wichita, Kans. Check the reply card.

Eaton 2-Speed Axles For Your Trucks

264. Truck axles that provide easy shift, supply positive lubrication and have a self-contained air brake are available from Eaton Mfg. Co. For complete information on these rugged axles check the reply card or write Eaton Mfg. Co., Cleveland, Ohio.

How to Solve the Brush Disposal Problem

277. Fitchburg Chippers, engineered to solve the brush disposal problem, reduce troublesome brush and trimmings to tiny, easy to-dispose-of chips. Several models are available to meet your needs. May be mounted on truck body or on trailer, tractor or jeep. Full details in interesting, profusely illustrated 16 page bulletin. Write Fitchburg Engineering Corp., Fitchburg, Mass.

Helps Solve Bridge Concrete Problems

363. Special aids for common problems of bridge designers and builders. Case histories, usual and unusual, are given in Bulletin MBR-P 11. Address The Master Builders Co., P R Dept., Cleveland 3, Ohio, or check the card.

The Principles of Compaction by Vibration

388. Compaction specifications that can't be met with ordinary compactors are no problem to the new Essick vibrating rollers. Complete descriptive literature explaining the principles of compaction by vibration and the Essick vibrating roller is available from Essick Mfg. Co., 1950 Santa Fe Ave., Los Angeles, Calif.

Tractor-Shovels With Drott "Four-In-One" Attachment

252. Hough rubber-tired front-end loaders come equipped with the Drott "4-in-1" bucket. Check the reply card or write The Frank G. Hough Co., Libertyville, Ill., for literature on how to use this unit as a shovel, clamshell, scraper and bulldozer.

Information on Boring Machines

368. General operating instructions for the Earthworm boring machine, a portable compact unit for underground installation of pipe and conduit are available in new bulletin just released by Earthworm Boring Machine, Inc., P. O. Box 1100, Santa Monica, Calif. Suggested procedures for installing pipe or conduit and a price list are included.

Motor Graders With Torque Converter and Power Shift Transmission

420. Complete operation data and specifications of Huber-Warco motor graders are covered in Bulletin No. HWG521 available by checking the reply card or by writing Huber-Warco Co., Marion, Ohio.

For Prompt Service Use The Reply Card

Self-Propelled Ditching Machines

428. Information on a self-propelled one man operated ditching machine, model 524 T, model W-2 and a new midget ditcher, model 4 T, for light construction is now available from the Vermeer Mfg. Co., Pella, Iowa. The Model 524 T digs 8 to 24 inches wide and down to 6 feet deep, while the model 4 T digs 6 to 14 inches wide and down to 4½ feet deep. Model W-3 Ditcher digs from 2" wide up to 4" down to a depth of 30". Full data on these ditchers available by checking the reply card.

Levels Sidewalks and Curbs Quickly and Easily

518. How the Mud-Jack Method for raising concrete curb, gutter, walks and streets solves problems of that kind quickly and economically without the usual cost of time-consuming reconstruction activities—a bulletin by Koehring Company, 3026 W. Concordia Ave., Milwaukee 16, Wis. Check the reply card.

DRILL MASONRY *at Greatest Savings — 50, 60, 70%*
with NEW Truco Portable Diamond Drilling Equipment

New Model B
- Holes up to 14"
- Electric or Air
- 6 Power options
- 2 Base options

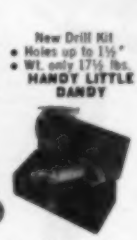
HEAVY DUTY WORK HORSE

New Model A
- Holes up to 6½"
- Electric, Air or Gasoline
- 5 Power options
- 2 Base options
- Truck mount

WORLD'S MOST VERSATILE

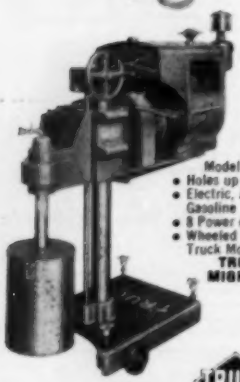
New Model S Drill Stand and Hand Drill Motor
- Holes up to 5½
- 3 Power options

LOW COST THRIFT CHAMP



New Drill Kit
- Holes up to 1½"
- Wt. only 17½ lbs.

HANDY LITTLE DANDY



Model G
- Holes up to 20"
- Electric, Air or Gasoline
- 8 Power options
- Wheeled Base or Truck Mount

TRUCO'S MIGHTIEST

Truck mounted unit swings down into position for accurate, vertical drilling wherever a truck can go. Electric, air or gasoline power.

Truco Original Diamond Drill Bits *revolutionized* masonry drilling by proving savings up to 70%. Sizes ¼" through 20" O.D. Standard lengths 4½" and 12". Other sizes and lengths to order. Full line of accessories.

5 NEW MODELS PLUS POWER COMBINATIONS= 16 MODELS

Electric, air, gasoline power

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10 NEW FEATURES of use, economy, performance

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Clean, accurate holes ¼" to 20"

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Roller base, or base plate or truck mounted models. Drill ANYWHERE

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Complete line of engineered, matched accessories

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World's cleanest, quietest, thriftiest hole drilling. No edge patching.

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Truco equipment often pays for itself in a single day or on a single job.

Booths 97-98-99 Masonry Contractors Show, Feb. 21-24, Cincl.

Booths 1439-1443 Plant Maintenance Show, Jan. 25-28, Phila.

Write for NEW illustrated catalog

TRUCO MASONRY DRILLING DIVISION

WHEEL TRUEING TOOL CO.

114-3200 W. Davison Avenue • Detroit 38, Michigan

To order these helpful booklets check the reply card opposite page 34.

1960 Truck Line Story From Chevrolet

446. The 1960 Chevrolet truck line is described fully in literature from Chevrolet Motor Division, General Motors Corp., General Motors Building, Detroit 2, Michigan. Check the reply card for data on this line of 165 models.

Ultra-Clean Sweeping For Streets, Yards and Airports

499. A new approach to extra-clean sweeping is described in a 4-page illustrated Bulletin (No. 83.55) issued by the G. H. Tennant Co., 795 N. Lilac Drive, Minneapolis 22, Minn. Described is a 7'4" path sweeper that eliminates the use of water for dust control. Check the reply card.

Complete Line of Road Rollers and Compaction Equipment

520. Buffalo-Springfield's complete line of road rollers and compaction equipment is described in a 12-page illustrated Buletin No. S-73-157 just released by Buffalo-Springfield Roller Co., Division of Koehring Co., Springfield, Ohio. Check the reply card for on-the-job pictures, as well as construction details of the 2-axle tandems, 3-axle tandem, 3-wheel rollers and the K-45 Kompactor.

Pre-Assembled Dowel Units For Highway and Airport Construction

537. Lacledo dowel assemblies for expansion, contraction and construction joints are precision welded into one unit and are maintained in rigid alinement. For full details write Laclede Steel Co., St. Louis, Mo., or check the reply card today.

Complete Line of Asphalt Patching Mixers

586. Mixers capable of mixing 3 to 20 tons of hot mix per hour are described in literature available from McConnaughay Mixers, Inc., Lafayette, Ind. Check the reply card for full information on patching, repairing, resurfacing and sealing.

Vacuum Cleaner and Leaf Collector For Cleaner Streets

595. A unit is now available that can be mounted on a right-hand drive jeep or a pick-up truck for picking up gutter trash and leaves. Complete specifications, capacity, operation and installation procedures are covered in a bulletin available from Tarrant Mfg. Co., Saratoga Springs, N. Y.

Sweepers Handle A Variety of Jobs In Every Season

684. Mechanical drive one-way and pull type 2-way sweepers and hydraulic 2-way sweepers that are tractor-mounted or loader-mounted are fully covered in literature from M-B Corp., 1611 Wisconsin Ave., New Holstein, Wisc. Jobs like cleaning dust, dirt and snow from streets and highways and sweeping park lawns are a few of the sweepers applications. Check the reply card.

BUSINESS ADMINISTRATION

Save Space By Filming Your Records

57. Microfilm your records by using the Recordak Microfilmer. Check the reply card or write Recordak Corp., 415 Madison Ave., New York 17, N. Y., for operation, use and price of this machine. Also available is literature on the Recordak Verifax Copier that makes certified copies 15 times faster than typing.

Monthly Time and Cost Record Book

349. To assist owners in determining the cost of owning and operating equipment Caterpillar Tractor Co., News Service, Peoria, Ill., has prepared a 24-page monthly time and cost record book. Twelve sets of pages are included on which to record day by day machine expenses for an entire year. Check the reply card for your copy.

AIRPLACO

ADVANCED DESIGN EQUIPMENT SAVES DOLLARS ON CONCRETE WORK

SAVE on bridge repair

SAVE on sidewalk and curb repair

SAVE ON ALL CONCRETE CONSTRUCTION AND RESTORATION WITH AIRPLACO

You save cold, hard cash when you use AIRPLACO "Advanced Design" concrete gunning and placing equipment. You save valuable time—speed up work. Save on labor—fewer men get more work done. Save on materials—get higher efficiency, more versatility. Investigate AIRPLACO for your next concrete job.

COMPLETE LINE

AIRPLACO offers you a complete line of concrete guns, portable mixers, grouters, placers, sandblasters and a complete line of accessories.

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AT YOUR SERVICE — Draw upon the experience of the world's leading manufacturer of pneumatic concrete placing equipment. Let us help you solve your concrete maintenance and restoration problems. Write, wire or phone, anytime.

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WORLD'S LEADING MANUFACTURER OF "ADVANCED DESIGN" PNEUMATIC PLACING EQUIPMENT

To order these helpful booklets check the reply card opposite page 34.

CONSTRUCTION EQUIPMENT AND MATERIALS

Data on Portable Hydraulic Earth Borer

138. Complete specifications on the Holan hydraulic earth borer are available from J. H. Holan Corp., 4100 West 150th St., Cleveland 11, Ohio. Check the reply card for literature.

Ford Tractors Equipped With Loader of 2500 lb. Lift

162. New Ford tractors give you multi-job versatility with a full line of attachments. Check the reply card or write Tractor and Implement Div., Ford Motor Co., Birmingham, Mich., for data on this rugged and powerful tractor.

What You Should Know About Air-Placed Concrete

67. For a detailed explanation of the principle of "gunned" or "air-placed" concrete and description of the improved Model 750 and 1250 Bondactors, be sure to get your copy of Form 553 from Air Placement Equipment Co., 1011 W. 24th St., Kansas City 8, Mo. Check the reply card today.

Backfill Rammer Packs a Heavy Punch

120. Powerful Wacker Model GVR 100-C Rammer weighs only 115 pounds so it's in the Bantam-weight class, but it delivers ten powerful blows per second to compact 20 square feet per minutes. Durable, compact and easy to operate, it gets into tight corners and meets toughest compaction requirements. Full details from Wacker Corp., Hartford, Wisc.

Modern Compaction Methods and Equipment

200. This 52-page Manual covers modern day compaction methods and equipment, rubber-tire rolling, compaction of asphalt mixes, aspects of vibratory compaction, stage compaction on cohesive soils and compaction of asphaltic concrete surfaces. Check the reply card or write Road Machinery Div., Bros Inc., 1057 Tenth Ave., S. E., Minneapolis 14, Minn., for your copy.

A Fully Rotary Compressor by Jaeger

209. Complete information is available from The Jaeger Machine Co., Columbus 16, Ohio on this 2-stage, oil-cooled rotary compressor. Features include 80% fewer moving parts, up to 30% less weight, vibrationless operation and 100° cooler air.

Drilling Machine For Concrete

221. The Truco diamond drilling machine is described in literature available from Truco Masonry Drilling Div., Wheel Trueing Tool Co., 15-3200 W. Davison Ave., Detroit 38, Mich. Unit will cut reinforced or plain concrete.

Barber-Greene Continuous Asphalt Plants

230. This catalog covers the Model 848-A asphalt plant and presents each typical plant setup and separately shows the details of each component. Check the reply card or write Barber-Greene, Aurora, Ill., for your copy.

Catalog on Utility Bodies and Equipment

360. General service bodies, line construction bodies, aerial equipment, winch and derrick equipment and trailers are the units covered in this catalog. For design, dimensions, illustrations and descriptions check the reply card or write McCabe-Powers Auto Body Co., 5900 N. Broadway, St. Louis 15, Mo.

Specification Sheets on John Deere Tractors and Equipment

560. Information and specifications on the John Deere crawler and wheel-type industrial tractors and working equipment. Deere & Co., Industrial Division, Moline, Ill. Check the reply card. State type of tractor and equipment.

The Tractors that Put the Utility into Utility Tractors

618. Low profile, high clearance, and a new Shuttle clutch, power steering are a few features. For the full story write Allis-Chalmers Mfg. Co., Milwaukee 1, Wis., for Utility Tractors literature, or circle our card-number.

Light Duty Trucks For Construction and Maintenance

638. Pickup and stake body trucks, regular and four wheel drive, are fully described in literature from Ford Div., of Ford Motor Co., Dearborn, Mich. Pickups are available in 6½, 8 and 9-ft. lengths. They come in standard colors and with either a 6 or V-8 engine. Rigid tailgate and steel corner posts add to the over-all body strength. The stake body trucks come in 6½, 7½ and 9-ft lengths. These units also come in 6 or V-8 engines. Check the reply card for full information.

Color Catalog Describes "Michigan" Tractor Dozers

631. A 20-page catalog on "Michigan" Models 180, 280 and 380 tractor dozers covers the design and operating features and explains how the hydraulic controls regulate all dozer operations. For your copy write to Construction Machinery Div., Clark Equipment Co., P. O. Box 599, Benton Harbor, Mich., or check the reply card.

Portable Water Coolers Used on Maintenance and Construction Work

651. Igloo cans and coolers are permalined and range in capacity from 2 to 15 gals. Models and sizes are covered in bulletin available from Igloo Corp., P. O. Box 8227, Memphis 4, Tenn., or by checking the reply card.

(More listings on page 52)

You don't buy a "Pig in a Poke" when you invest in

WISCONSIN-POWERED farm equipment

Model 76 Toro Professional Gang Mower Unit, made by Toro Manufacturing Corp., Minneapolis, Minn. Powered by Wisconsin model AENL 4-cycle single cylinder engine.

When leading builders of modern power equipment install Wisconsin Heavy-Duty Air-Cooled Engines on their newest, most advanced machines . . . *you know* and *they know* that the engine must be *right!*

The equipment builder can't afford to take chances because the *engine* is the operating heart of his machine. It must be field-tested and approved by the original equipment manufacturer before final selection.

The engine must measure up to the equipment builder's performance and quality standards . . . both *mechanically* and *on the job.* His good judgment is backed by more than 50 years of engine-building experience when he specifies "Wisconsin" as original power equipment for his machines.

So we repeat . . . you don't buy "a pig in a poke" when you invest in Wisconsin-powered equipment.

All Wisconsin Engines are of heavy-duty design and construction. They are engineered and built to stand up to hard service and weather extremes from low sub-zero to 140° F. In addition, the engine is custom-engineered to fit both the machine and the job. And that's why it pays to specify "Wisconsin Power" for your equipment.

Write for free copy of engine bulletin S-249. Address: Dept. P-20.

WISCONSIN MOTOR CORPORATION
MILWAUKEE 46, WISCONSIN
World's Largest Builders of Heavy-Duty Air-Cooled Engines

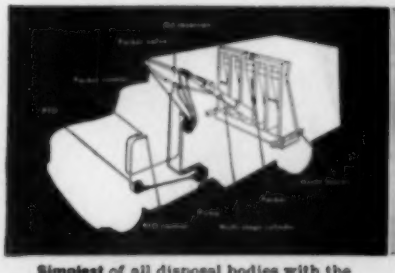
U-126

Hydro E-Z Packs save 4 hours per man per day!

MR. C. E. COULTER
Peoria Disposal Co.

"Eight E-Z Packs handle the load 64 dump trucks carried"–

In Peoria, Ill., the Peoria Disposal Co. makes money with a fleet of 8 Hydro E-Z Packs against tough competition. Loads baled under 76,600 lbs. pressure in the world's most powerful refuse compactor average 5 to 8 tons compared with only about 1200 lbs. carried in the company's old non-compacting bodies. Company President C. Elmer Coulter reports that 8 Hydro E-Z Packs handle 4 times the load 16 dump trucks carried—and save 4 hours a man a day formerly lost on extra trips to the landfill! But see for yourself. See your Hydro E-Z Pack distributor or write us. We'll help arrange a demonstration and send you a free copy of "The Big Squeeze."



Simplest of all disposal bodies with the fewest working parts. No complicated chains, conveyors or whirling knives.

Bulldozer plow travels length of floor for compaction, beyond body for clean unloading of bale. No hoisting needed.

Lower cost with less depreciation since elimination of heavy and complicated mechanism decreases chassis requirements.

Hydro E-Z PACK

HYDRO E-Z PACK®

HYDRO E-Z PACK DIVISION OF HERCULES GALION PRODUCTS, INC., GALION, OHIO – U.S.A.

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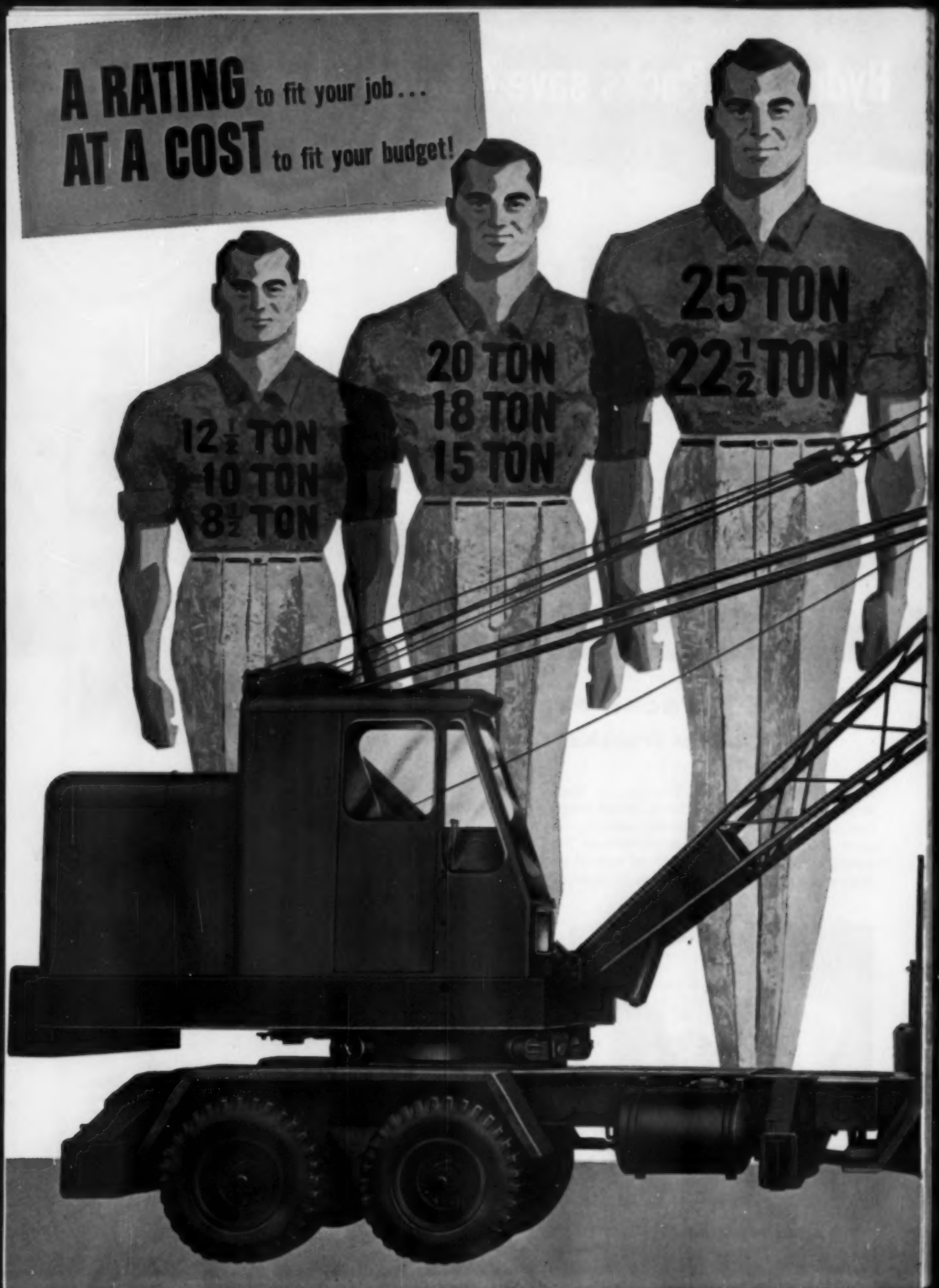
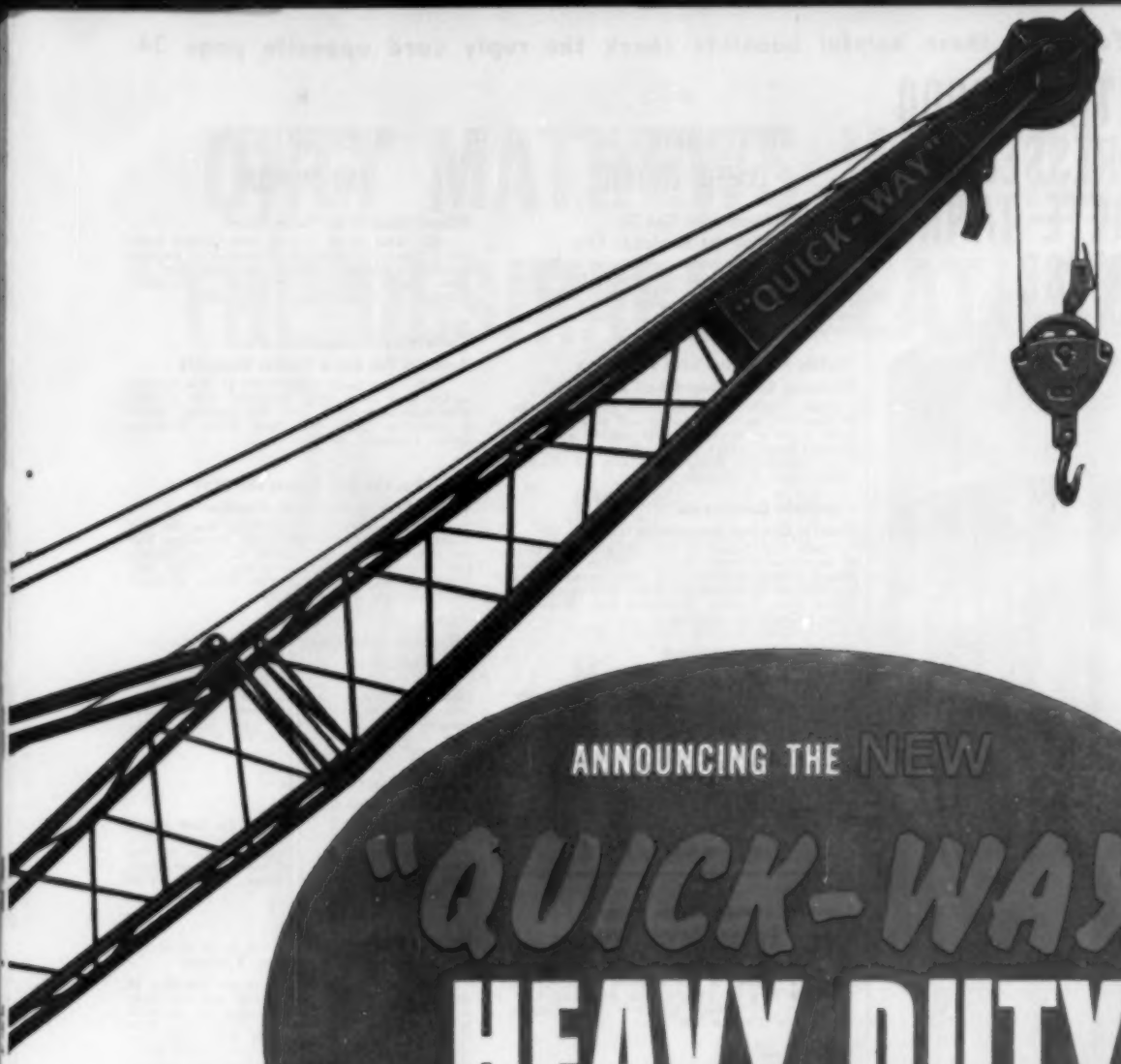

A RATING to fit your job...
AT A COST to fit your budget!
12½ TON
10 TON
8½ TON
20 TON
18 TON
15 TON
25 TON
22½ TON



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HEAVY DUTY TRIO

OF TRUCK CRANES AND SHOVELS

New Full Vision Cab
New Controls With Underfloor Mounting
New More Accessible Machinery Housing
Heavier Main Frame
Larger Segment Type Clutches and Brakes
Bolt On Cast Counter Weight

Write For Full Details... "QUICK-WAY" TRUCK SHOVEL CO., DENVER 5, COLORADO

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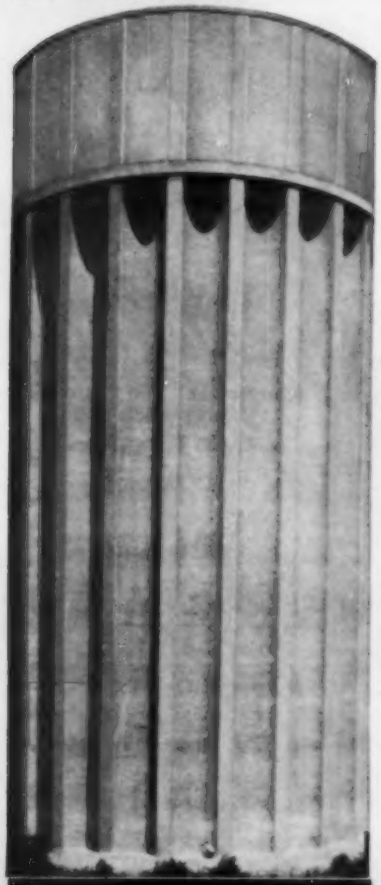
MORE THAN 2000 PRESTRESSED CONCRETE TANKS IN SERVICE



Look at these features:

- Minimum maintenance
- 75% construction cost spent locally
- Satisfied owners
- Longest service life of any tank
- Lowest overall cost

Send for Bulletin T-22

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351 Jefferson, Dallas, Texas

PRELOAD CONCRETE STRUCTURES INC.
837 Old Country Road
Westbury, Long Island, New York

HERRICK IRON WORKS
28400 Clawiter Road
Hayward, California

THE CANADA GUNITE COMPANY, LTD.
7325 Decarie Blvd.
Montreal 16, Canada

STREET LIGHTING AND TRAFFIC CONTROL

Damaged Barricades Can Be Repaired With PM Barricade Kits

163. PM barricade kits provide a flexible replacement system for damaged barricades. Check the reply card or write Pacific Mercury, 13232 Leadwell, No. Hollywood 9, Calif., for details on PM transistor neon or incandescent flasher warning lights.

Traffic Protection with AmBridge Highway Beam Guard Rail and Posts

205. USS AmBridge beam guard rail can be furnished in 25-ft. lengths and with the steel posts make a strong, highly visible and economical guard rail. Check the reply card or write American Bridge, Division of United States Steel, Pittsburgh, Pa.

Complete Catalog on Traffic Control Equipment

240. All types of controllers, PR system of coordinated traffic control, vehicle detectors, timers, vehicle counters and radar speed meters are covered in catalog available from Automatic Signal Div., Eastern Industries Inc., Norwalk, Conn. Check the reply card.

All-New Transistorized Mobile Radio

243. General Electric's complete, new transistorized mobile radios are available in 10, 30 and 75-watt ratings, 150-174 mc. The design of these units permit front-mounting in any make or model car or truck. For catalog on specifications, models and operation write to General Electric Co., Communication Products Dept., Lynchburg, Va.

Use The Reply Card

Lighting Standards for Every Outdoor Lighting Requirement

284. Complete design details, typical installation photos and how Hy-Lite standards are made are covered in this valuable guide. Check the reply card or write to the American Concrete Corp., 5092 North Kimberly Ave., Chicago 30, Ill., for Catalog 400.

Manual on All Types of Traffic Signs

379. This 26-page manual covers regulatory, warning, school, railroad, street name, road construction, route markers, miscellaneous signs and plastic reflectors. Check the reply card or write The Miro-Flex Co., Inc., 1824 East Second St., Wichita 14, Kans.

Handbook on Aluminum Traffic Control Devices

516. Subjects covered in this handbook are sheet signs, extruded signs, sign posts, street signs, and complete specifications for many aluminum uses. A list of Alcoa sales offices is included. Check the handy reply card or write to Aluminum Company of America, Alcoa Building, Pittsburgh 19, Pennsylvania, for mounting, determining size of sign posts and other information today.

Let Progress Hit Your Highway Signs, too

575. An overlaid plywood especially engineered for highway sign construction is now available in natural surface for reflective overlays, also in green or white. AASHO approved. Resistance to damage cuts maintenance costs. For GPX description and specifications write Georgia-Pacific Corporation, Equitable Bldg., Portland 4, Oregon, or circle number on our card.

Literature on Reflective Glass Beads

690. Glass beads for traffic signs and street name signs are described in literature available from Flex-O-Lite Mfg. Corp., 8305 Flex-O-Lite Drive, P. O. Box 30665 (Affton Br.), St. Louis 23, Mo. Beads can be used on white and yellow signs. Check the reply card.

REFUSE COLLECTION AND DISPOSAL

Where Does It Go From Here?

63. That is the title of new 12-page booklet, D 930, with thorough discussion of garbage disposal by sanitary landfill method. Read the latest report from the experts. Caterpillar Tractor Co., Peoria, Ill., or check card.

Versatility, Compaction Force Account For Extra Packer Capacity

139. The many advantages of this modern packer unit have been combined into a fact-filled bulletin entitled "The Big Squeeze" which is available from E-Z Pack Div., Hercules Galion Products, Inc., Galion, O.

Load-Packer 600 Points the Way to the Best in Refuse Collection

188. Bulletin W-200 explains how the Gar Wood Load-Packer gives faster operation, bigger payload, more compaction, a larger hopper and more dependable operation. Write Gar Wood Industries, Inc., Wayne, Mich., or check the reply card for full details.

Literature Describes M-B Contain-O-Pack System

190. A 6-page catalog describing the M-B Contain-O-Pack, a complete low cost containerized refuse system for private haulers and municipalities is available from M-B Corp., New Holstein, Wisc. Check the reply card.

Bulk Refuse Collection with Super Roto-Can

192. A bulletin describing the bulk refuse system called the City Tank Roto-Can, which provides an unusual flexibility of service and the handling of all types of trash, is available from City Tank Corp., Corona, N. Y. Check the reply card.

General Specifications for Refuse and Garbage Trailers

251. Two bulletins, one on the Pak-Mor 38 cu. yd. tandem axle trailer unit and the other on the Pak-Mor 32 cu. yd. trailer for use with Model GRD Dempster are available from Pak-Mor Manufacturing Co., Box 6147, San Antonio, Texas. General specifications, power train, operating procedures, maintenance and lubrication and other helpful information are included.

Modern Methods in Sanitary Landfills

699. Up-to-date data, pictures and explanation of sanitary landfill, its methods and equipment are covered in this valuable bulletin from The Oliver Corp., 19300 Euclid Ave., Cleveland 17, O. Check the reply card for information on satisfactory garbage and refuse disposal methods.

SNOW AND ICE CONTROL

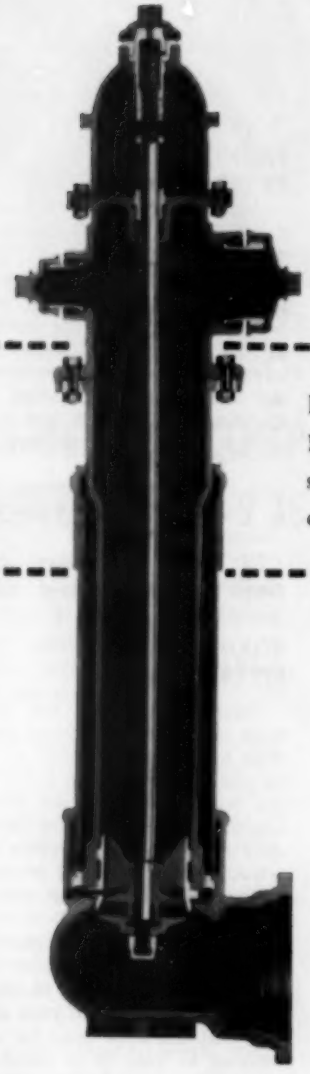
Uniform Salt Spreading Saves Material

42. The wide, thin pattern provided by Tarco "Scotchman" spreaders avoids salt waste, saves time and labor. Get Folder BL for full details on their spreader and table of material application rates. Use reply card or write Tarrant Mfg. Co., Dept. PW, Saratoga Springs, N. Y.

Formulation for use in Thermal Snow and Ice Removal Systems

493. The properties and advantages of Dowtherm SR-1, a heat transfer fluid, and typical installation layouts are covered in catalog available from The Dow Chemical Co., Midland, Mich.

ONLY MATHEWS HAS ALL THE DESIRABLE FEATURES



What do you look for in a hydrant? Dependability... replaceable barrel?... conventional packing?..."O" ring seal?...stop nut to prevent stem from buckling? We could double this list and still not cover all the features we build into Mathews Hydrants *by design.* Mathews has them all.

DEPENDABILITY

Mathews Hydrants are always ready for service, because their design is fundamentally sound and simple. In 90 years we have never changed the basic design—only refined it, by detail.

AND ALL THESE OTHER FEATURES, TOO: All working parts contained in replaceable barrel • Head can be faced in any direction • Replaceable head • Any nozzles you specify • Nozzle levels raised or lowered without excavating • Leakproof because stuffing box is cast integral with nozzle section • Operating thread only part requiring lubrication • Protection case of "Sand-Spun" cast iron for strength, toughness, elasticity • With bell, mechanical joint or flange pipe connections

Conform to latest AWWA specifications

R. D. WOOD COMPANY

Public Ledger Building, Independence Square, Philadelphia 5, Pa.

Manufacturers also of Mathews Flange Barrel Hydrants, R. D. Wood Hydrants, R. D. Wood Gate Valves, and "Sand-Spun" Pipe (centrifugally cast in sand molds)

STREET and PARK

Type 48-F

Refuse Receptacles

Tarco **"Paragon"** receptacles have gobbled litter and trash **since 1883.**

Rugged construction: welded, heavy gauge steel. Large capacity. Locking removable hoods. **Two big doors,** vertically hung, open and close without springs. **Safe to use** . . . no scraped fingers. Stainless steel feet. Baked enamel finish. Decals. Innerliners.

TARRANT MFG. CO.

28 Jumel St.
Saratoga Springs, N. Y.

SAVE LABOR
with
ROADMASTER
Hot Asphalt Plant
It's Completely Automatic

The only self-contained asphalt plant, with fully automatic aggregate batching and asphalt metering, specifically designed for municipalities. Available as stationary or mobile unit. Costs no more than manually operated plants. SAVES THE LABOR OF AT LEAST ONE MAN. Rotary dryer with forced draft. Twin-shaft pugmill with enclosed oil-bath gear box. Enclosed bucket elevator and reciprocating feeder. 400 gallon asphalt tank. Cyclone-type dust collector. Send for 8 page, illustrated brochure.

WYLIE MANUFACTURING CO., INC.
P. O. BOX 7286 • OKLAHOMA CITY 13, OKLA.

FILLING ON A FLY ASH DUMP

The Pennsylvania Department of Highways has a proposed project which will pass over a fly-ash dump. The August, 1959 issue of Public Works has on Page 174 a reference to an article entitled "Fly Ash as Bulk Fill." This article appeared in May 27, 1959 issue of Contractors Record and Municipal Engineering.

A search of the local library failed to turn up the publication in which this article was written. Could you kindly furnish this office with any additional information that you may have on this subject.

William C. Bernstein
Soils Engineer
Pa. Dept. of Highways
1118 State St.
Harrisburg, Pa.

Will our readers who have additional information on this subject of fly-ash as a bulk material write Mr. Bernstein, sending a copy to the Editor of PUBLIC WORKS.

GRIT REMOVAL IN SEWAGE TREATMENT

It has occurred to me that the method of grit removal described on page 100 in your December issue of PUBLIC WORKS deserves some comment. The problem of removing grit from grit settling tanks, in sewage treatment plants especially, has long been a problem and also one of the most annoying jobs for the operator.

In the Superior, Wisconsin, plant rubber-lined pinch valves are installed vertically in the bottom of each hopper in the grit tank. These valves are normally in the open position which permits grit to settle into the pipe below the valves. At intervals, depending upon the amount of grit, the pinch valves are closed by pressure. The pipe line can be run to any desired point and by the simple process of flushing the pipe, the grit will be carried to that point. Either air or liquid may be used for the flushing and for the operation of the pinch valve. It is necessary, of course, to use a higher pressure on the line which closes the pinch valves than is used to flush the pipe. A velocity in the pipe line of about 20 feet per second is desirable. The entire process is controlled by solenoid valves and a time clock which is adjusted to meet conditions in any plant.

This is a patented process (No. 2,907,461) which has proved very satisfactory.

K. E. Madsen
Executive Vice-President
Hitchcock & Estabrook
Consulting Engineers
Minneapolis, Minn.

PACK RAT EXTERMINATOR

Congratulations for printing that fine article by W. W. Coburn titled "Are You a Pack Rat?" My job here is pack rat exterminator, and it would be very helpful to have copies of that article for distribution in the department. May I please have your permission to reproduce the article for distribution in the Highway Department and to three or four other state agencies.

Keith Putman
Records Management Officer
State Highway Department
Salem, Oregon

Ed. Note: Permission granted, gladly.

ROADSIDE LITTERING

Your editorial in the January issue on "Litter Problems and One Way to Eliminate Them" is of particular interest to me for it places the finger on one of the more disheartening aspects of the unwillingness in some suburban areas to meet requirements for even modest expenditures in connection with refuse collection and disposal.

I am sending along a paper written by me as far back as 1951 in which I voiced many of the same views as expressed in your editorial and which I hope may be of some interest to you. It is certainly my earnest hope, as well as yours, that action will be forthcoming in the not too distant future to correct many of the existing conditions which cannot help but breed unsightliness in areas surrounding many of our urban centers of population.

Wm. A. Xanten
Supt., Division of Sanitation
District of Columbia
Washington, D. C.

Here, PSR-9 compacts gravel road in Jefferson County, Wisconsin. Kneading action of pneumatic tires, plus oscillating action on all 9 wheels, helps the PSR-9 key and lock loose materials in place. Helps eliminate hairline cracks when rolling asphalt, too.

HIGH-DENSITY COMPACTION . . . ODD-LOT ROLLING . . . PSR-9 IS EFFICIENT ON BOTH

Has the weight capacity you need for heavy-duty force account compaction . . . the economy you need for odd-lot maintenance.

You're looking at the world's most modern pneumatic roller — introduced last year and designed *from the ground up* to answer your needs for more efficient rolling. The PSR-9 gives you 3 to 10 tons of compaction weight on 9 wheels. All wheels oscillate for contour compaction. There's one-half inch overlap between front and rear tires . . . over-all rolling width, 5'8" per pass.

Sliding gear transmission with torque converter gives operator smooth, infinite speed selection over 3 speed ranges, at up to 15 mph in both directions. Direction of travel and speed are both controlled by single combination lever for easier and more accurate shuttle rolling and control.

Other operator controls include power steering, and power brakes. Low center of gravity, mechanical parking brake, and short 18'10" outside turn radius are other features your operators will like. Why not get the most quality your dollar will buy in your next pneumatic tire roller? See the PSR-9, or bigger 10 to 30-ton companion model PSR-30 . . . today.

New forward-reverse throttle (arrow) gives operator instant one-lever control of direction and speed. Push forward for forward travel, pull back for reverse . . . that's all there's to it!

"Big brother" to the PSR-9, 7-wheel PSR-30 offers 10-30 ton compaction weight . . . speeds to 19.4 mph forward and reverse. Note how dual controls, plus special frame contour, give operator clear view of both guide and drive wheels on either side.

Tell me more about the
☐ PSR-9 ☐ PSR-30

NAME
COMPANY TITLE
ADDRESS
CITY, STATE

8-18-PW

BUFFALO-SPRINGFIELD COMPANY SPRINGFIELD, OHIO
A Division of Koehring Co.

BUFFALO-SPRINGFIELD COMPACTION EQUIPMENT • FLAHERTY SPREADERS AND SWEEPERS • STARDRILL-KEYSTONE DRILLING MACHINES

engine power
BY CATERPILLAR

Cat Electric Sets are the economical answer to many prime and standby power problems

You need power for a growing community—or to catch up with a population shift. You want to back up utility power with emergency power for public health and safety. You have to augment regular power in certain seasons. Or you need the answer to a special electrical supply problem of your own.

In any case, dependability and economy must be parts of your answer. Solution? Caterpillar Diesel Electric Sets. Sets in capacities from 30 to 375 KW serve local, county, state and federal governments in just about every application.

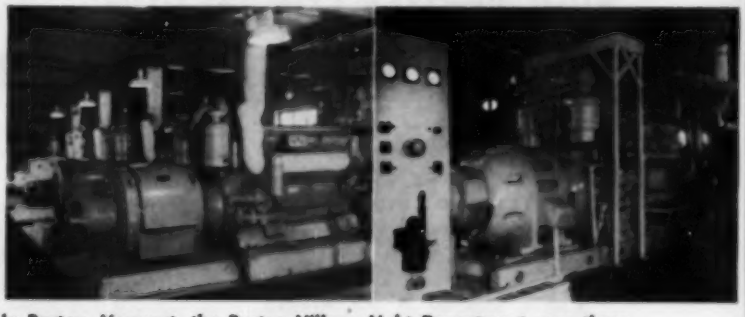
When used for prime power, Cat Electric Sets have the stamina to run and keep on running with minimum attention. They need little routine care. When they do, care is easy to perform.

On standby, Cat Electric Sets can be equipped with automatic start and stop controls. They take over the load in seconds, carry it for as long as you need it.

All Cat Diesel Electric Sets operate on the lowest cost diesel fuel available—without clogging. You can install them without building special structural support. Or you can take portable sets where you need them.

Our point is—if you have an electrical power problem that seems to have a costly solution, your Caterpillar Dealer may prove otherwise. Call him and ask to talk with his Engine Specialist. Or please write to us for further information on Cat Electric Sets for prime and standby power.

Lakeland Institution, Lakeland, N. J., hospital for psychiatric, chest disease and general patients, almshouse, county farm and workhome, guards against power failure with a Cat D375 Electric Set. Many hospitals qualify for matching federal funds for emergency power.



In Barton, Vermont, the Barton Village Light Department uses these four Caterpillar D397's to augment hydroelectric power source. Sets run for short periods or weeks. One summer month, electric sets furnished 478,000 of 520,000 KW-hours.

Cordova, Alaska—rapid growth required immediate additional power. So a Caterpillar D397 Electric Set was installed. Nearness of parts and service was an important reason for choosing Caterpillar.

CATERPILLAR

Engine Division, Caterpillar Tractor Co., Peoria, Illinois, U. S. A.

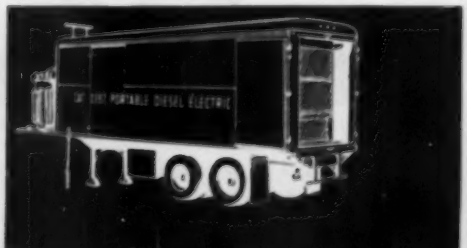
Caterpillar and Cat are Registered Trademarks of Caterpillar Tractor Co.

Authoritative answers to any questions you have on diesel engines and electric sets are available through your Caterpillar Dealer Engine Specialist. He works with your engineers to get the best solution to your power problems.

What diesel fuels are available? Choose the lowest cost one for your Cat Diesel Electric Set. They use No. 2 Furnace Oil efficiently. And don't worry about fouling or clogging. Also, Cat Natural Gas Engines operate on butane, propane—even sewage gas.

Caterpillar Diesel Engines and Electric Sets are available for your installations—in disposal plants, water works, electric utilities—for primary or standby power. Portable electric sets move easily to where they're needed.

DES



MODERN AS TOMORROW

Plant Superintendent: Harold W. Augenstein
Consulting Engineers: Consoer, Townsend & Associates, Chicago

Primary tanks with Rex Conveyor Sludge Collectors and Roto-Skim Pipes.

Final tanks with Rex Unitube Tow-Bro Sludge Removers.

HAMILTON, OHIO, PLANT

Planned For Peak Performance

The Hamilton, Ohio, new split activated sludge sewage treatment plant is a tribute to sound planning that considered not only today's but tomorrow's requirements. In anticipation of a substantial population and industrial expansion, the planning team designed a plant that would provide maximum efficiency with adequate reserve capacity for future growth of the community.

The new plant has a designed average flow of 12 m.g.d., with a maximum designed flow of 18 m.g.d. handling both municipal and industrial wastes. In the design of the Hamilton plant, maximum utilization of available area was accomplished through a compact arrangement of the treatment units by using common wall construction throughout.

The grit chambers, equipped with Rex Chain and Bucket Grit Collectors, and the rectangular primary tanks, with Rex Conveyor Sludge Collectors and Roto-Skim Pipes, are neatly grouped with the rectangular aeration tanks and the three square final tanks. Future expansion of these units with a minimum of cost is guaranteed.

In the final tanks, Rex Unitube Tow-Bro Sludge Removers assure maximum flexibility in operation ...both today and for years to come. With more positive and general removal of sludge, the Tow-Bro provides ample facilities for efficient operation under varied conditions.

Rex Waste Treatment Engineers are available to help design and select equipment for modern plant performance as at the Hamilton, Ohio, plant. For complete information, write CHAIN Belt Company, 4722 W. Greenfield Ave., Milwaukee 1, Wisconsin.

REX®

CHAIN BELT COMPANY

Specialized Equipment for the Effective Treatment of Water, Municipal and Industrial Wastes.

Municipal Power

EFFECTIVELY GROUNDED NEUTRAL ELECTRIC SYSTEMS

BRUCE J. ENNIS
Principal Engineer,
Burns and McDonnell Engineering Co.,
Kansas City, Missouri

THROUGHOUT the country, there are still many electric distribution systems in successful operation in which the phase conductors on the overhead pole line circuits are electrically isolated from a neutral, or zero potential ground point. Such un-grounded neutral or delta connected circuits have certain inherent advantages such as relative freedom from imparting triple harmonic interference to paralleling communication circuits, and the ability to operate without service disruption in the event that one (but only one) conductor should become electrically grounded.

Actually, a delta connected circuit is not fully isolated from ground. The phase conductors, themselves, form the plates of a condenser, with the air between the pole line wires and the ground serving as the dielectric, so that the conductors are electrostatically coupled to earth and are charged to a potential above earth zero corresponding to the equivalent line-to-neutral voltage of the nominal circuit rating. By such coupling, the phase conductors of a 2400 volt delta, three phase distribution feeder are each kept at a potential of 1386 volts above ground. Should one of these conductors become accidentally grounded, its line-charged capacitance is discharged and that conductor will continue to operate at a potential gradient of zero volts above ground, but at the same potential of 2400 volts to each of the other two, unfaulted, conductors. In this instance, the other two phase conductors will operate at a potential of 2400 volts above ground zero, until the faulted conductor's accidental ground is removed.

For a given size and arrangement of line wires, the line charging capacitive KVA of a circuit will increase lineally with the length of the circuit, and approximately as the square of the voltage at which it is operated. Thus, in the case cited above, the accidental grounding of one phase of a 2400 volt delta feeder would, of course, be accompanied by a spark or flash of more or less severity, depending on the length of line wire subjected to capacitive discharge. If this same feeder were being operated at 13,800 volts delta, however, the faulted line charging KVA would be over thirty times as great, with the increased possibility of arcing or intermittent grounding and transient over voltages. To eliminate such troubles, most present day circuits rated 11 KV and above are designed for operation as grounded neutral rather than as delta circuits.

For a given insulation level, three phase electric systems operated with the neutral grounded will permit 1.732 times as much load distribution for a given conductor size as an ungrounded system. Expressed in another manner, a 4160 volt three phase, four wire wye grounded neutral circuit will experience only one-third as much voltage regulation as a 2400 volt three phase, three wire delta ungrounded neutral circuit carrying the same load, or will carry the same KVA load three times as far for the same percentage voltage regulation.

Both circuit arrangements permit the use of standard 2400 volt single phase distribution transformers; however, the delta system requires two lightning arresters and two fused cutouts per single phase transformer installation, whereas the wye system requires only one each of these devices for each distribution transformer.

For these reasons, many existing ungrounded systems have been, and are being, converted from delta to wye operation, such as 2400 volt delta to 4160 volt wye; 7200 volt delta to 12,470 volt wye, and so on. In addition to the necessary installation of a fourth, neutral conductor along the pole line feeder circuits, the reconnection of substation and distribution transformers from delta to wye, etc., it is a matter of considerable importance to assure proper and effective grounding of the system's electric neutral to eliminate or minimize troubles that might develop from an improperly established neutral grounding system.

In order to prevent abnormally high transient line-to-neutral voltages on the two unfaulted phases of a three phase, four wire circuit, during a line-to-ground fault on the third phase conductor, and to minimize voltage shift by stabilizing the neutral so as to permit the circulation of unbalanced load current in the neutral, it is necessary to provide a low zero sequence impedance to ground, in relation to the positive sequence impedance.

Generally speaking with normal ratios of reactance to resistance, the transient line to neutral voltage shift during line-to-ground faults will not exceed 130 per cent of normal on unfaulted phase conductors provided the ratio of zero sequence to positive sequence system reactance is maintained at 3.0 or less. This permits the use of "grounded-neutral" lightning arresters for maximum protection to equipment without the danger of damage to the arresters, themselves, that would result due to the sustained power discharge that would flow through the arresters if the unfaulted phase voltages were permitted to rise excessively.

In order to permit unbalanced load distribution on a three phase, four wire feeder, the ratio of zero sequence to positive sequence reactance should be maintained at 1.0 at all points in the system, if possible, and this ratio should never exceed 1.5 to 2.0; otherwise, voltage shift due to unbalanced load currents would result in un-acceptably high voltages on phase conductors carrying the lightest loads.

Characteristically, the zero sequence reactance of single circuit distribution pole lines is 3.5 times as great as the positive sequence reactance. A given feeder emanating from a substation with a standard delta-wye connected transform-

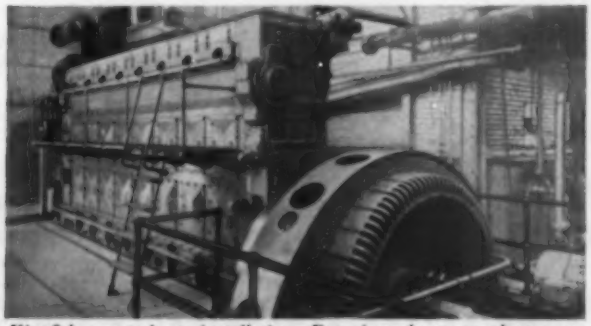
Superior's low fuel oil consumption is measured here by (left to right) Clarence Garrett, Plant Supt., A. B. Reese, Jr., White's Chief Field Engineer, and V. V. Long, Engineering Consultant, Kingfisher, Okla.

Civic thrift at Kingfisher prompts Superior Engine purchase

Kingfisher, an Oklahoma wheat belt town of 3700 population, is proud of its low municipal taxation. Earnings from the city-operated power plant pay most local operating expenses and finance periodic improvements and expansion to the plant itself. As usual, city fathers were both cautious and thrift-minded when a new engine-generator was needed recently. Their choice was a Model 80-GDSX-8 dual-fuel supercharged Superior which develops 1769 BHP at 360 RPM, to drive a 1250 KW generator.

Today many municipalities are making a "Superior decision"! Superior's highly developed open chamber combustion system is combined with a series of exclusive design developments and refinements to produce high power-to-fuel ratio. Diesels can run on a wide range of non-premium fuels including residuals, and dual-fuels operate on natural or manufactured gas, butane, propane or sewage gas. Even after extremely long periods of low-maintenance operation, replacement parts are seldom needed.

Superior's complete line of diesel, dual-fuel and gas engines range from 190 to 2150 HP, or 150 to 1500 KW. Get full information today by writing to:



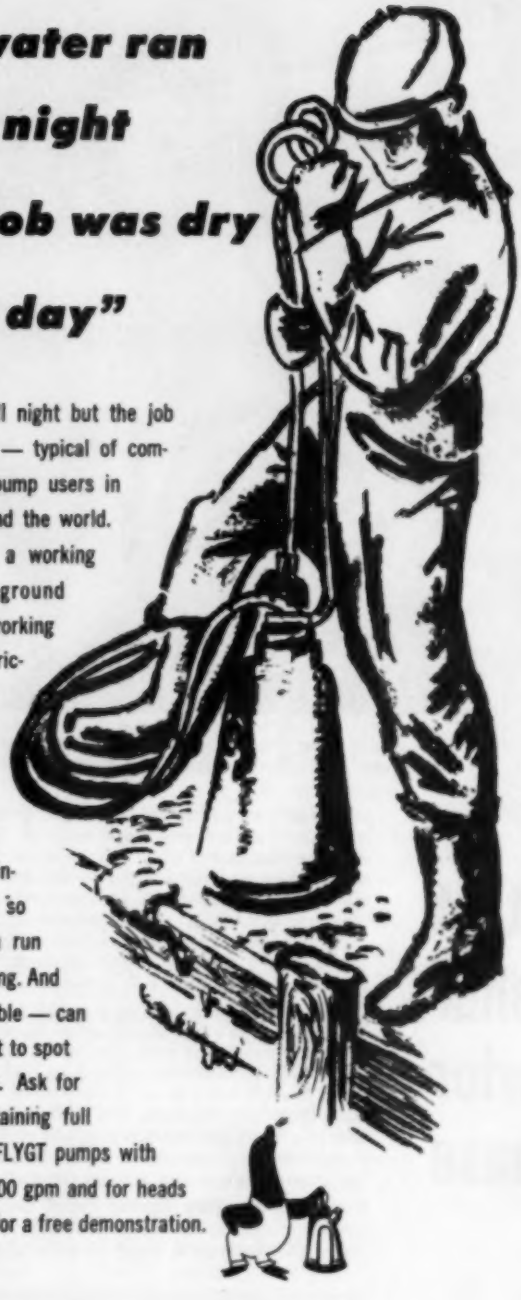
Kingfisher saved on installation. Experienced power plant crew poured base and completed hook-up.

Superior Engines · Atlas Diesel Engines · White Diesel

White Diesel

WHITE DIESEL ENGINE DIVISION
THE WHITE MOTOR COMPANY
Plant and General Offices: Springfield, Ohio

"The water ran all night but the job was dry all day"



"The water ran all night but the job was dry all day." — typical of comments by FLYGT pump users in 60 countries around the world. You needn't lose a working minute draining ground water from your working site. FLYGT electric-powered, fully submersible pumps can be run day and night with virtually no supervision and little maintenance. They are so simple anyone can run them without training. And they are fully portable — can be moved from spot to spot as the job requires. Ask for our literature containing full information about FLYGT pumps with capacities up to 3100 gpm and for heads up to 220 ft. — or for a free demonstration.

FLYGT

97-3

STENBERG MANUFACTURING CORPORATION

HOOSICK FALLS, N. Y.

WESTERN SALES & SERVICE: STANCO MFGS. & SALES INC., 1666 Ninth St. (Corner of Olympic) Santa Monica, Calif.

PUMP BETTER ELECTRICALLY - USE FLYGT!

er bank would have a zero to positive sequence reactance ratio of 1.0 at the substation. This ratio increases progressively along the feeder due to the higher rate of increase of zero sequence reactance relative to the positive sequence reactance. As a result, a long circuit might require the use of "ungrounded neutral" lightning arresters at its terminus, even though grounded neutral "lightning arresters satisfactory at its source, or substation end. In cases of this kind, it is sometimes necessary to install a grounding transformer bank at the end of long feeders to provide additional neutral stabilization and thus prevent excessive voltage shift throughout the entire length of the feeder.

• • •

Travel To and From Airports

In a report on preliminary studies for a new major airport for the New York - New Jersey Metropolitan area, the Port of New York Authority, which operates LaGuardia, New York International and Newark Airports, presents data on the travel habits of air passengers. Experience at the airports in this area shows that the vast majority of air passengers get to and from the airport in their own automobiles or by taxicab rather than by the airport coach service or any other means of public transportation. Surveys indicate that the pattern of passenger travel to and from the New Jersey and New York airports is as follows: 40 percent of the passengers use their own cars; 31 percent use taxicabs; 27 percent use the airport coach service and 2 percent use other means of transportation, including public buses and helicopters.

Sewage Treatment by a Virginia County

The total flow through the Arlington Co., Va., sewage treatment plant for the 1958-59 year was 5,724.3 million gallons. The average daily flow was 15.7 million gallons. The plant renders primary treatment to all of Arlington's sewage. The treatment process removed an average of 72.5 percent of the suspended solids and 41.6 percent of the biochemical oxygen demand. A total of 5,019.5 tons of sludge cake was produced by the vacuum filters. The estimated sludge gas production was 200,000 cubic feet per day. The cost of operation was $42.36 per million gallons or $1.28 per capita.

Expressing the NEW Spirit of St. Louis...

HANDSOME, URBAN APARTMENTS STRENGTHENED WITH LACLEDE STEEL

Creeping obsolescence, a serious disease of many big cities, has been stopped in its tracks by St. Louis' dynamic Urban Redevelopment Program.

Acres of slums are being swept away, to be replaced by modern commercial and residential structures, an industrial park, and a civic sports center and stadium. Traffic clogged arteries are being widened; new freeways completed; and existing buildings stripped of their somber cloaks of soot and grime. A whole new spirit of civic progress is being enkindled.

One expression of this new spirit is the Plaza Square Apartments project, six 13-story middle-income dwellings in the very shadows of downtown skyscrapers. These handsome structures will add beauty and vitality to the city's strategic central core.

Laclede reinforcing steels of all types were used extensively in the contruction of the Plaza Square Apartments. In fact, most of the big concrete jobs in St. Louis, and many more throughout the country, utilize Laclede reinforcing steel for greater strength and durability.

PLAZA SQUARE APARTMENTS
St. Louis, Missouri

Architects: *Hellmuth, Obata & Kassabaum, Inc., and Harris Armstrong (St. Louis);* ***General Contractors:*** *Paul Tishman Company, Inc., and Frain-Colnon Contracting Co., acting as agents for Plaza Construction, Inc. (St. Louis);* ***Structural Engineer:*** *William C. E. Becker (St. Louis);* ***Concrete Contractor:*** *Knickerbocker Construction Company, Inc. (New York).*

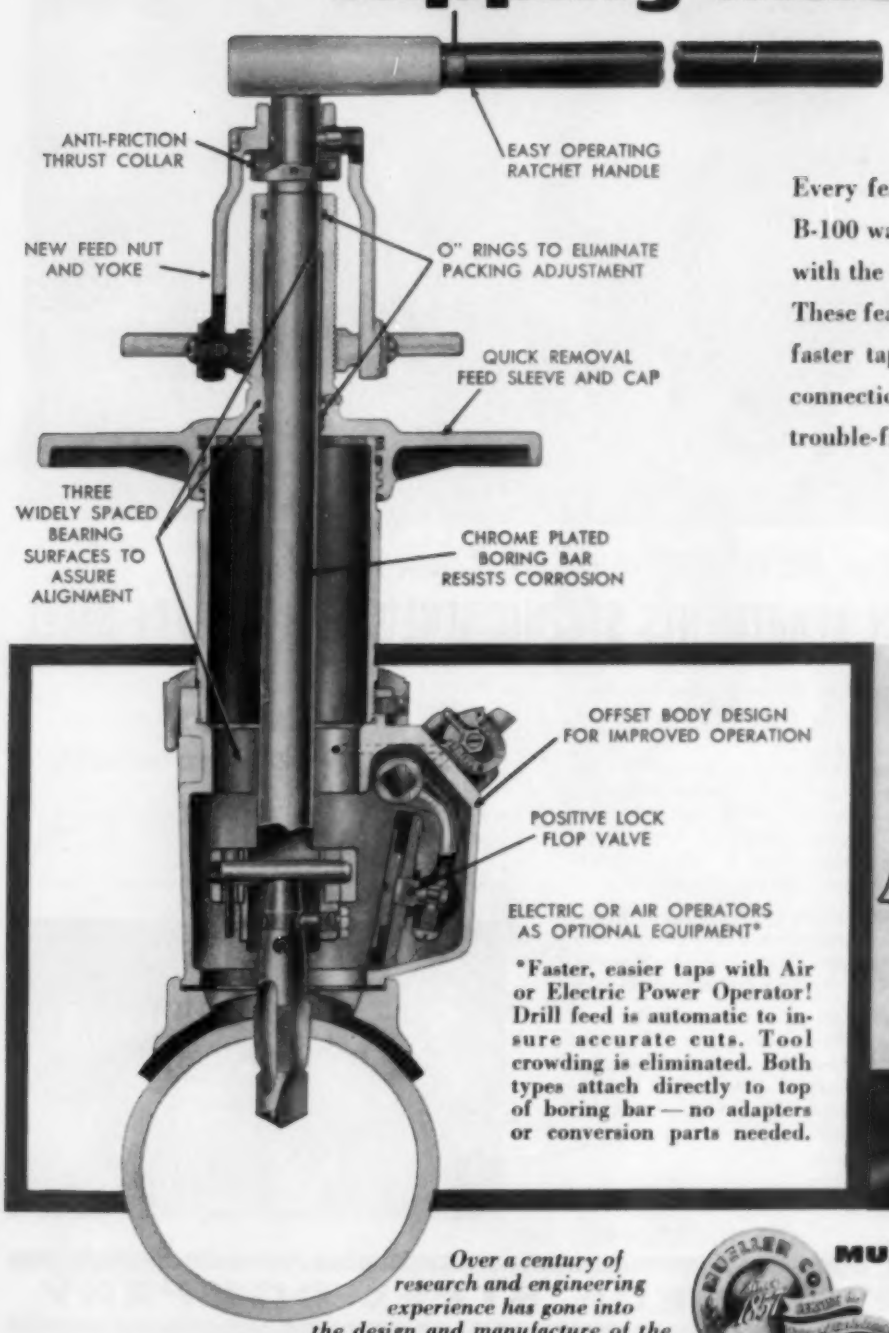
LACLEDE

LACLEDE STEEL COMPANY

SAINT LOUIS, MISSOURI ◆ Producers of Steel for Industry and Construction

operators like the ease . . .
the speed . . . the accuracy of the new

MUELLER® B-100 tapping machine!


ANTI-FRICTION THRUST COLLAR
EASY OPERATING RATCHET HANDLE
NEW FEED NUT AND YOKE
O" RINGS TO ELIMINATE PACKING ADJUSTMENT
QUICK REMOVAL FEED SLEEVE AND CAP
THREE WIDELY SPACED BEARING SURFACES TO ASSURE ALIGNMENT
CHROME PLATED BORING BAR RESISTS CORROSION
OFFSET BODY DESIGN FOR IMPROVED OPERATION
POSITIVE LOCK FLOP VALVE

Every feature of the new B-100 was designed with the operator in mind. These features give you faster taps, pressure-tight connections and easy, trouble-free operation.

ELECTRIC OR AIR OPERATORS AS OPTIONAL EQUIPMENT*

*Faster, easier taps with Air or Electric Power Operator! Drill feed is automatic to insure accurate cuts. Tool crowding is eliminated. Both types attach directly to top of boring bar — no adapters or conversion parts needed.

Over a century of research and engineering experience has gone into the design and manufacture of the B-100 Drilling, Tapping and Inserting Machine.

MUELLER CO.
DECATUR, ILL.

Factories at: Decatur, Chattanooga, Los Angeles; in Canada: Mueller, Limited, Sarnia, Ontario.

HIGHWAY AND ROAD DEPARTMENTS ←

STOP WEEDS

WITH ONE APPLICATION OF

SIMAZINE
PRE-EMERGENCE HERBICIDES
ATRAZINE
PRE- and POST-EMERGENCE HERBICIDES

effective control of most broadleaf weeds and grasses.

safe to humans and animals.

FREE BROCHURE: New full color booklet contains complete directions, diagrams, applications and other useful data for both Simazine and Atrazine. Address: Department PW-2

Apply Simazine or Atrazine herbicides once. Get full season weed control on road shoulders, around guard rails, and other places where weeds cut visibility or mar highway appearance. Both Geigy herbicides available as 80% wettable powder and 4% granules.

GEIGY AGRICULTURAL CHEMICALS • Division of Geigy Chemical Corporation
Saw Mill River Road, Ardsley, N. Y.

Here's another reason why Ford Trucks are your best buy!

"OF ALL THE MAKES WE'VE TRIED FORD TRUCKS GIVE US THE LOWEST MAINTENANCE COST!"

ANOTHER REPEAT BUYER OF FORD TRUCKS

Virgil E. Cook, owner of Cook Block and Brick Co., is convincing proof that there is still plenty of opportunity in American business for those sound planning, hard working individuals who want to own their own business. Starting from scratch just 13 years ago, he now owns and operates one of the largest concrete products plants in Eastern Indiana. The workhorses in his fleet of 16 trucks are three Ford Tilt Cab Tandems that are used to haul sand and gravel to the plant and make deliveries in and around Anderson.

Hard-working Ford CT-950 tractor leaves Cook gravel pit with 18 yards of aggregate. Aluminum walking beam and rubber suspension system of tandem axle assembly reduce chassis weight, permit higher legal payloads.

Cook's CT-850 with special flat-bed body and Side-O-Matic unloader delivers blocks right to the job site. Unit carries 600 concrete blocks and spots them where needed.

"Our experience has proved that Ford Trucks can be operated at substantially lower maintenance costs than any other make we've tried. And, equally important in a fleet like ours, we find that our Fords spend much less time in the shop. None of the Ford units purchased since 1958 have been in for major repairs and I am still amazed at the way the older ones keep going.

"The best truck we've ever owned is a 1954 Ford C-700 that consistently carries a load of 350 to 400 blocks over all types of terrain. In spite of this severe work it ran 125,000 miles before we replaced the engine. This unit now has over 140,000 miles on the original ring gear and pinion and it went 60,000 miles before we relined the brakes and put in a new clutch. This is outstanding mileage when you consider that we've realized as little as 12,000 miles from competitive ring gear and pinion sets. Clutch and brake life obtained with other makes in identical service was only 20,000 miles. It's results like this that keep our costs low and convinced us that we should stay with Fords when we bought our bigger trucks in '58.

"Our 1958 and 1959 Ford Tilt Cab Tandems give every indication of equalling or surpassing the fine records set by the C-700. The two CT-950 tractors hauling sand and aggregates to our processing plant breeze through traffic and take the hills like they weren't there at all. Our CT-850 equipped with a flat-bed body has the power and traction to deliver finished products anywhere. With Ford's tilt-cab design we get a real plus as far as payload is concerned because we can carry at least 2,000 pounds more weight on the front axle.

"We buy Ford Tilt Cab Trucks because we think they're the best engineered and most modern gasoline trucks in the heavy-duty field. Here at last is a truck built to permit big legal payloads with enough power to move these loads at economical speeds. We pride ourselves on our modern and efficient equipment and consider our Fords one of the most valuable assets of our business."

'60 Fords are built for longer life . . . with Certified Durability!

Whatever your job . . . wherever you do it . . . you'll discover just as Mr. Cook did, that Ford Trucks are the best investment for your transportation dollar.

Certified results of tests conducted by America's leading independent research organization (name available on request) confirm the fact that Ford Super Duties have been refined for still more durability! Automatic radiator shutters, improved electric fuel pumps and redesigned wiring harnesses are typical of the advancements to be found in these units.

Automatic radiator shutters reduced the coolant temperature variation recorded in severe mountain road tests from a 79° range to a 20° range. Engine operation with coolant temperatures in the 167° to 187° range means less expansion and contraction, more efficient combustion and better lubrication . . . all of which contribute to longer engine life.

Dynamometer tests showed *no vapor lock* with Ford's submerged-type electric fuel pump at temperatures up to 200°. Incipient vapor lock with mechanical fuel pump resulted in a power loss of 9% under the same conditions. Shaker table tests plus constant exposure to oil, water and heat proved 1960 wiring harness to be *three times longer lived.*

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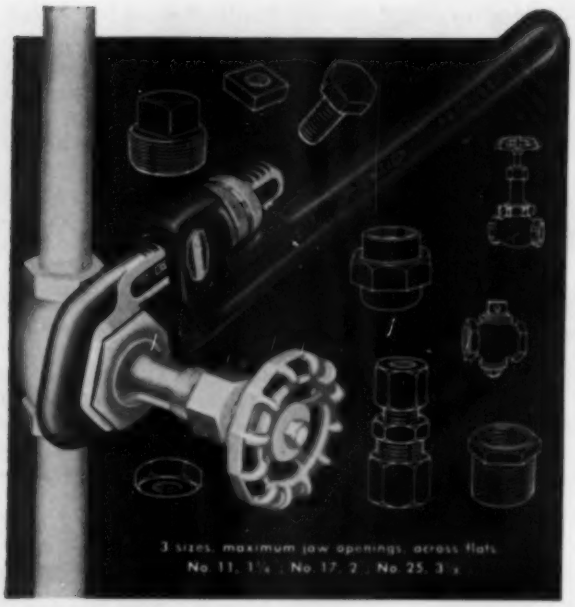

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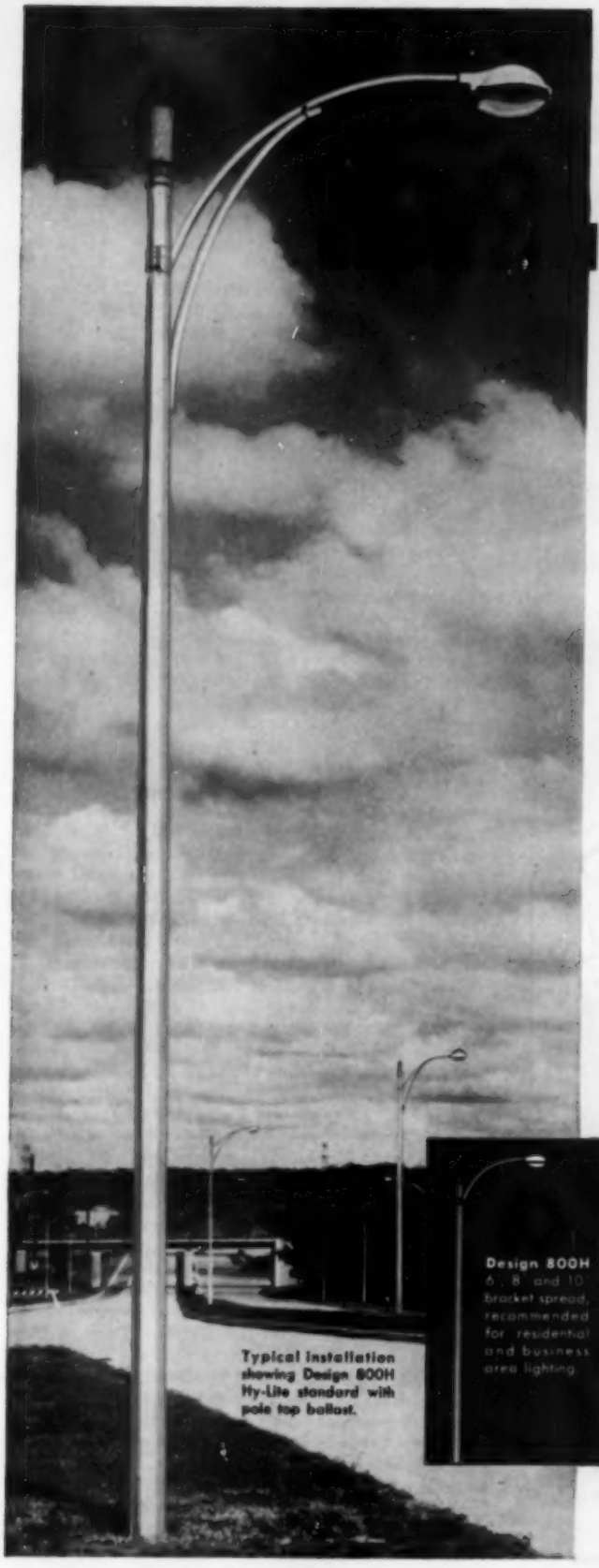
Diatomite Water Filters for Municipal Supplies

R. S. RANKIN
Consultant, Water and Sewage Treatment

DIATOMITE filters are an important development in water filtration and should have broader application in the municipal field. Unknown until about 17 years ago, they are now widely used for swimming pools and industry but only to a limited extent in treatment for municipalities. It seems that this field could be expanded considerably by application to many presently untreated impounded surface supplies where occasional turbidities are a vexing problem to the water utility and consumer alike. In such applications, pretreatment facilities are assumed to be unnecessary because the diatomite filter can be relied upon to treat successfully raw water with turbidity up to 50 to 60 mg/L. Moreover, diatomite filters can well be adapted to such seasonal operation. Considering the experience now available with this type of filter, engineers can justify serious examination of its merits for municipal supplies where the requirements are within its limitations and where cost and space are factors.

In the belief that many water engineers are likely to be too engrossed in routine standard practice to devote much time to newer developments, a few background remarks may prove useful.

The initial development and installation of diatomaceous earth (now shortened to diatomite) filters was done by the army for field use during World War II. This resulted in water processing equipment in many ways superior to the rapid sand filter previously used, not only in its greatly reduced bulk but in the quality of the filter effluent. For example, cysts causing amoebic dysentery were effectively removed by this new filter while the pressure sand filter failed to do so. After the war, Kiker (1) reports initial application to domestic use was made in 1947 in Florida in swimming pool filtration. Shortly thereafter the first municipal applications were made for small communities and up to August, 1956, there were 28 installations, the largest to serve a population of 10,000 and the smallest a few hundred, according to a survey by Bauman (2). Where properly engineered, that is with due consideration to the limitations of the diatomite filter, and where well operated, the installations have proven quite satisfactory. Since this survey was made undoubtedly a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number have been added, but progress is at a slow pace.

The filtering media in the diatomite filter is a thin layer of diatomaceous earth initially deposited from a slurry onto a supporting septum, which originally were either ceramic or wire wound porous tubes. Deposition of the media is done by circulating the slurry through the porous wall of the tube for a few minutes or until the effluent is clear, indicating the formation of a matte. For some waters this matte in itself may be adequate as a filter but if the solids are gelatinous in nature with a tendency to blind the filter, as is usually the case, a slurry of the filter aid known as body feed is fed continuously into the raw water. When mixed with the raw water solids this filter aid retards the increase in loss of head by preventing formation of an impervious matte.

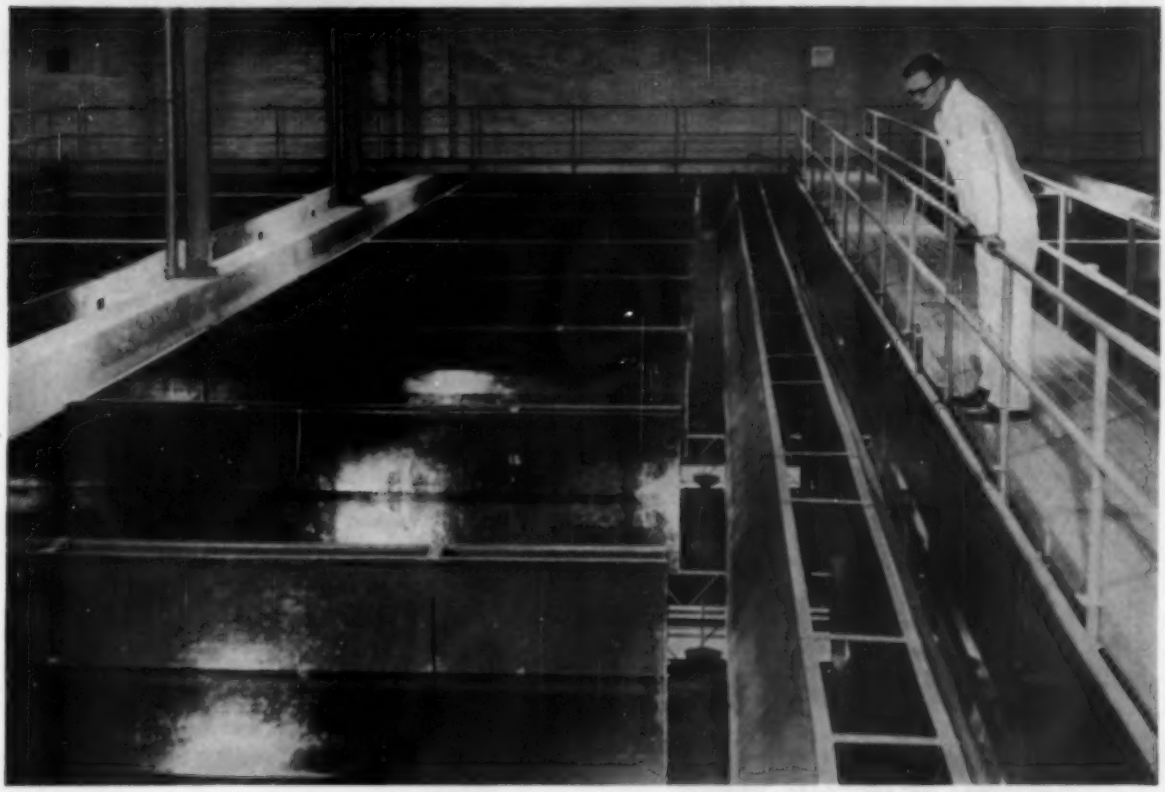
When the loss of head through the filter builds up to some predetermined value, the flow is shut off and the filter is cleaned either by reversing the flow or by surface jets. On filters with vertical media much of the accumulation frequently drops off as soon as the pressure is released. The time out of service for washing seldom is more than a few minutes, which is one advantage over the hour's time usually required for a complete cycle on the sand filter. Wash water requirements are much lower than with sand filters, averaging 0.2 to 0.25% of the water produced, which compares with 1 to 2% in the latter.

The actual filter media being only a fraction of an inch in thickness compared to the 30 or more inches depth in a sand filter, it is obvious that the diatomite filter is a great space saver. Filter elements must be in a container of sufficient volume to assure a uniform supply to each unit of area. However, even when this requirement is fulfilled, space saving is considerable. One commercial unit on the market includes 950 sq. ft. of filter area in 300 sq. ft. of floor area. Piping and auxiliary facility requirements are no greater than in sand filters so the overall space needed for a diatomite filter installation is considerably below the conventional type. This feature, combined with lower construction costs, have made the diatomite filter attractive to smaller communities.

Filter rates in diatomite filters vary from 1 to 5 gpm per sq. ft. and are a function of the loss of head across the filter media and the condition of the raw water. In installations where the filter elements are in pressure vessels, head losses up to 50 psi are possible and occasionally used. The tendency is to operate at filter rates around 2 gpm per sq. ft. and with pressure losses varying from 10 to 30 lb. per sq. in. At these lower filtration rates, runs up to 60 hours in length have been obtained. Conversely, filtration rates up to 5 gpm per sq. ft. usually result in runs of only a few hours. In other words, rates comparable with sand filters result in comparable head losses and lengths of filter runs, but the diatomite filter has an advantage of greater flexibility in this respect.

An interesting cost analysis of diatomite versus sand filters operating on the Raritan River in New Jersey made by Bell (3) shows that the first cost of a diatomite plant to treat 2 MGD with no pretreatment is about 55 percent of the cost of a rapid sand filter with pretreatment facilities, while annual costs of the two types including fixed charges are about a standoff. Sanchis and Merrell (4) in studies for Los Angeles made 8 or 9 years ago concluded that diatomite filters without the use of chemicals are capable of producing an effluent comparable to sand filters when treating surface waters in that area. Costs were

FLUIDICS* AT WORK



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estimated at very nearly the same, but where space is limited the diatomite possessed a decided advantage.

Operation of four municipal plants in New York serving populations from 700 to 5000 are discussed by Fraser (5) who concludes that for the variable conditions the plants must meet, they were doing a satisfactory job. Coulter (6) also describes a plant to treat water taken direct from the Catskill aqueduct to serve an area in Northern Westchester County. In this case the problem was one of removing fine turbidity in the aqueduct supply. Diatomite filters were selected over sand filters for reasons of economy including lighter foundation loads and less space required.

One confusing feature about diatomite filters as presently marketed is the lack of standardization of commercial units although time, combined with broader application, will undoubtedly remedy this. Some are cleaned by backwashing and some by surface wash; some operate by pressure on the raw water side of the filter, some by vacuum on the effluent and some by combination of preasure head on submerged unit and a vacuum on the outlet. There are probably other types. Each of these apparently has its merits and possibly its selective application. But until some uniform classification of types and respective field of application can be made, an engineer is going to hesitate before recommending it for use in the broad municipal field. Then there is the necessary approval of the regulatory agencies to be secured. Their reluctance to accept diatomite filters except in special cases is understandable. However, since the intrinsic merits of this filter type are fairly obvious it would seem that by diligent and concerted efforts, the manufacturers should have no trouble in producing a product capable of general acceptance.

The potential municipal field of application at present is in the treatment of unfiltered surface waters where annoying turbidities occur not infrequently and try the patience of the consumer. The infrequency of these occurrences is a good reason for considering a type of filter which is readily placed in operation and which costs initially much less than the typical rapid sand filter. In such applications the diatomite filter could perform a real service in turning out water free of turbidity the year around. The diatomite filter may not be adaptable or economical in its present form where pretreatment with chemicals is necessary but for waters containing little or no color and readily removable turbidity it should find ready application. There must be a place in the municipal water treatment field for the application of the diatomite filter with its adaptability and record of experience. That place could well be found in the treatment of unfiltered surface supplies which do not yield a quality water every day of the year.

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2) Diatomite Filters for Municipal Installations, E. Robert Bauman, *Jrnl. AWWA* Vol. 41, 1949, Pg. 174
3) Diatomite Versus Sand Filters. George R. Bell, *Jrnl. AWWA* Vol 48, 1956, Pg 1103
4) Studies on Diatomaceous Earth Filtration, Joseph W. Sanchis and John C. Merrell, Jr. *Jrnl. AWWA* Vol 43, 1951, Pg 475
5) Diatomaceous Earth Filtration in New York State, J. Kenneth Fraser, *Jrnl. AWWA* Vol. 46, 1954, Pg. 151
6) Diatomite Filters Treat Water from Catskill Aqueduct. Richard G. Coulter. PUBLIC WORKS Sept. 1957, Pg 125

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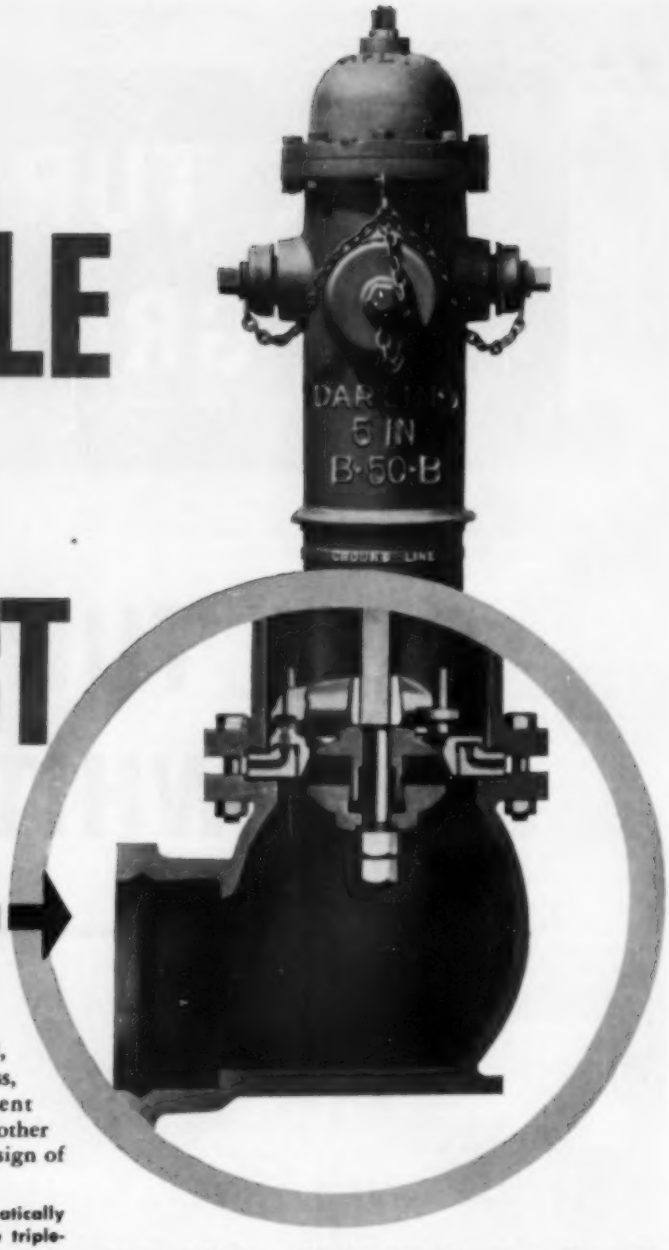

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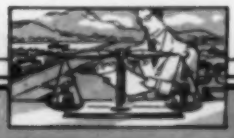

LEGAL ASPECTS OF PUBLIC WORKS

MELVIN NORD, Dr. Eng. Sci., LL.B.

Changing the Grade of a Street

Kenner v. City of Minot, 98 N.W. (2d) 901, a North Dakota case decided October 29, 1959, was an action by abutting property owners against the city to recover for damages caused by a change in the natural grade of a street. Before paving, the street was clay and gravel covered. The east side of the street, in its natural condition, was 1.8 feet lower than the west side and the street sloped toward the north. Sidewalks had been laid on both sides prior to paving the street, with the walks on the west side being higher than the east walks.

After the plaintiffs had improved their properties, the city paved the street. As part of the paving project, the city put in driveways leading to each of the properties. Because of the slope from the street to the sidewalk, the plaintiffs could not use their driveways without some difficulty. In response to their complaint, the driveways of all but one of the plaintiffs were changed by "dishing" the sidewalk, thus lowering the high spot of the driveway and making it somewhat more accessible.

The plaintiffs nevertheless filed suits against the city, claiming that the city changed the natural and established grade of the street, thus damaging the plaintiffs' property: (1) by making it difficult to enter from the street; (2) by making the street in front of the plaintiffs' properties unsafe for the plaintiffs to park; (3) by changing the normal flow from the street and subjecting the plaintiffs' properties to unnatural flow at times of thawing and surface runoff; (4) by requiring the plaintiffs to redesign and regrade their premises; and (5) by damaging the aesthetic appearance of the plaintiffs' properties.

The court dismissed the complaints, however, holding that this property had been dedicated for street purposes, and, where a property owner has dedicated a portion of his property for street purposes, he is presumed to have consented to the improvement of the dedicated portion for such purposes. It is only when such improvement is so out of the ordinary that it could not have been reasonably anticipated at the time of the dedication of the street that the owner is entitled to damages caused by the improvement.

Warning Flares on Sidewalks

Smith v. City of Jefferson, 99 N.W. (2d) 119, a Wisconsin case decided November 3, 1959, was an action by a child against the city for injuries sustained when her dress ignited on coming in contact with a flare warning against a sidewalk defect.

Kriederman owned property abutting on High street in the city of Jefferson. For more than two months prior to October 21, 1955, a gap of three squares, or approximately twelve lineal feet, had existed in the public sidewalk in front of such premises from which the concrete had been removed. Kriederman was fire chief of the city and he obtained from the city two unshielded open kerosene flarepots and placed one at each end of the gap. Such flares were maintained in a lighted condition during such two-month period, except that on some occasions Kriederman would extinguish them in the early morning and relight them at night. The kerosene used to fuel such flares came from the city's supply of kerosene.

At 10:30 o'clock on the morning of October 21, 1955, the flares were still burning. Patricia Smith, then aged four years and ten months, was playing on the sidewalk adjacent to one of such flares and her dress ignited from it and her body was severely burned as a result.

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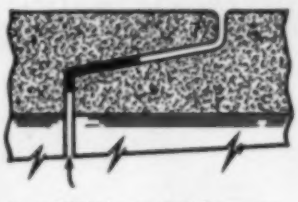
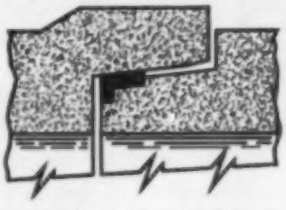


Type "C" Tylox under full compression. Note the visual inspection feature.



Type "C-P" Tylox under full compression. Flanges "lock" Gasket in proper position on the pipe offset.

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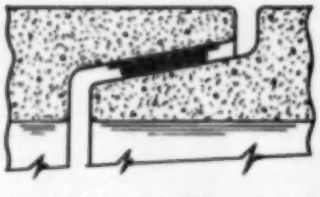

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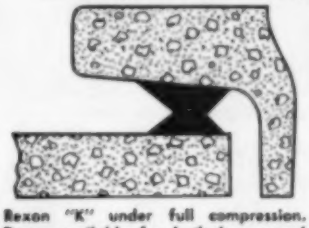

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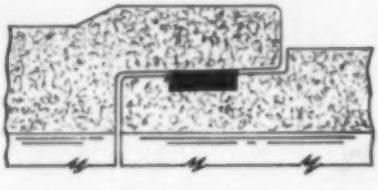

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The court held no cause of action was stated against the city under the attractive nuisance doctrine, but that the complaint did state a good cause of action grounded on the statute conferring a cause of action for damages sustained by reason of insufficiency or want of repair of a highway.

Controlled-Access Highways

Lehman v. Iowa State Highway Commission, 99 N. W. (2d) 404, an Iowa case decided November 17, 1959, involved a proceeding brought by the Highway Commission to condemn a strip of land for a new controlled-access highway across the farm of certain landowners. The landowners claimed that they were entitled to compensation for being deprived of access to their property from the new highway.

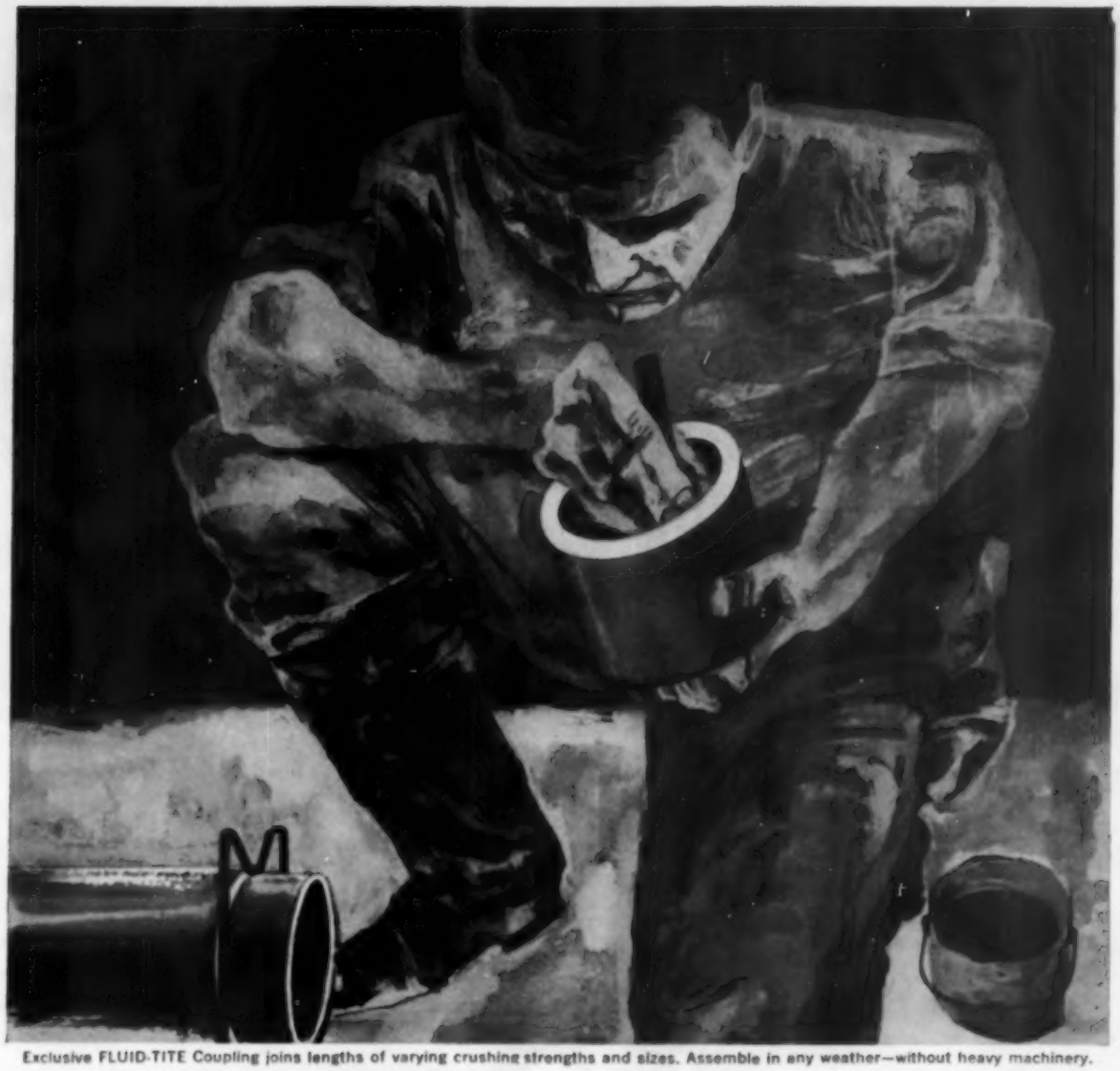
The court held, however, that they were not entitled to such compensation. They were not deprived of any right, since it never existed previously. They have the same access to their land from an existing highway as they formerly had.

• • •

Testing Equipment Used by Illinois Highway Department

A well equipped soils laboratory is maintained in the Bureau of Materials of the Illinois Division of Highways and in each of the ten highway districts. All ten of the districts are also equipped with truck-mounted drilling rigs capable of obtaining disturbed or undisturbed soil samples to a depth of 50 feet. The data obtained in the laboratories, and in the field, are used in design, construction and maintenance work. Special stability studies and analyses of specific problems of pavement support are also performed by the Bureau.

Automatic freeze-thaw apparatus and a Multi-Record Dynalog temperature recorder were installed in the concrete laboratory during the past year. This equipment will be used in connection with the acceptance and investigational tests of aggregate, concrete, and other materials. The freeze-thaw equipment is capable of lowering automatically the temperature of sixty 3 x 4 x 16-inch concrete beams to 0°F., and then increasing their temperature to 40°F. This cycle can be repeated eight or more times in a 24-hour period. The temperature recorder is capable of recording twelve different temperatures from 75°F to 2,200°F.



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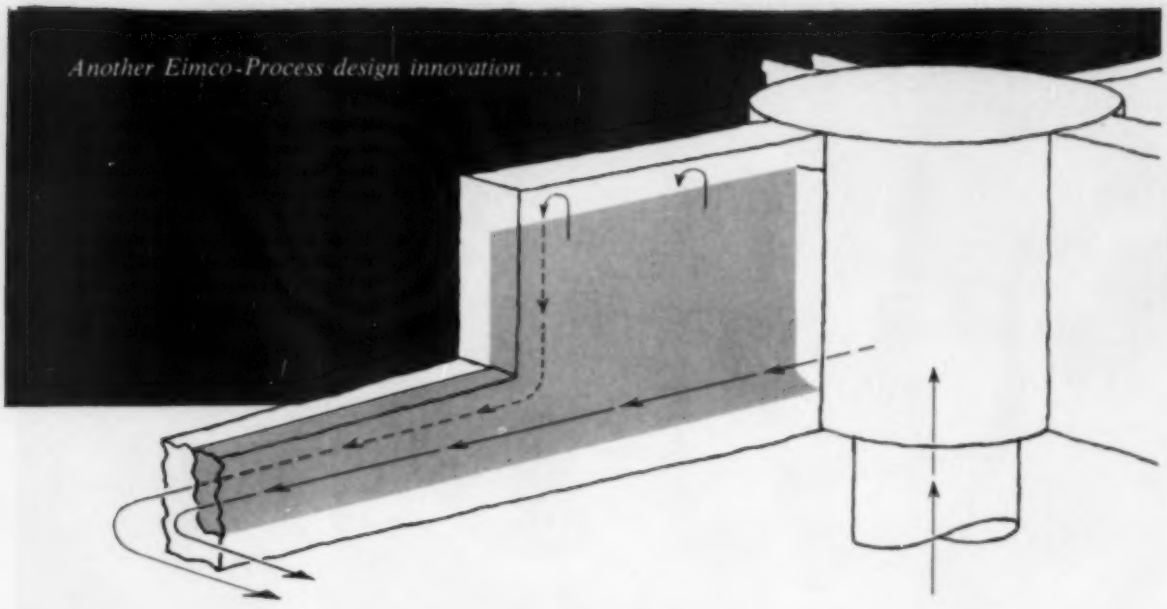

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Radial weir center assembly on a 102 ft. dia. high rate Rotary Distributor installed at the Arlington, Texas, Sewage Treatment Plant. Consulting Engineers—Reaves and Gregory, Fort Worth, Texas. All types of Eimco-Process Rotary Distributors are described in our new bulletin SM-1011 . . . a copy is yours on request.

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Building a road across Wisconsin's Horicon Marsh requires 50,000 tons of finely crushed base material. Sustained high production of crusher, powered by a 385 max. hp International UDT-817 diesel, keeps cost of hard stone (crushed to minus one inch) at only $1.56 per ton. Madison Stone Co. replaced an overworked engine with this new International, matching the power to the job.

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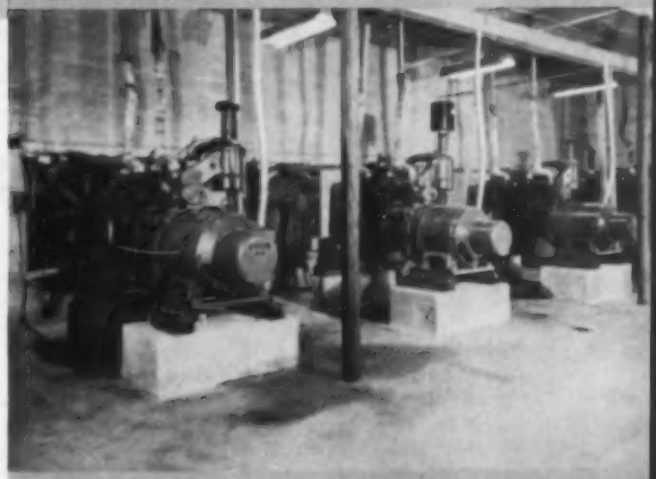

Electric power for the town of Beatty, Nev., is dependent on four International UD-1091 diesels. These Internationals power four 100-kw Palmer generators to give the year-in-year-out dependability that local officials expect from International.

Water insurance is provided for downtown Stockton by a 227 max. hp UV-549 V-8 engine. The California Water Service Co. has this standby engine hooked up to the main water system. If needed, it will supply 55 psi while pumping 3,000 gpm. against a 132-ft head. This carbureted unit was Stockton's choice for low-cost insurance against complete power failure.

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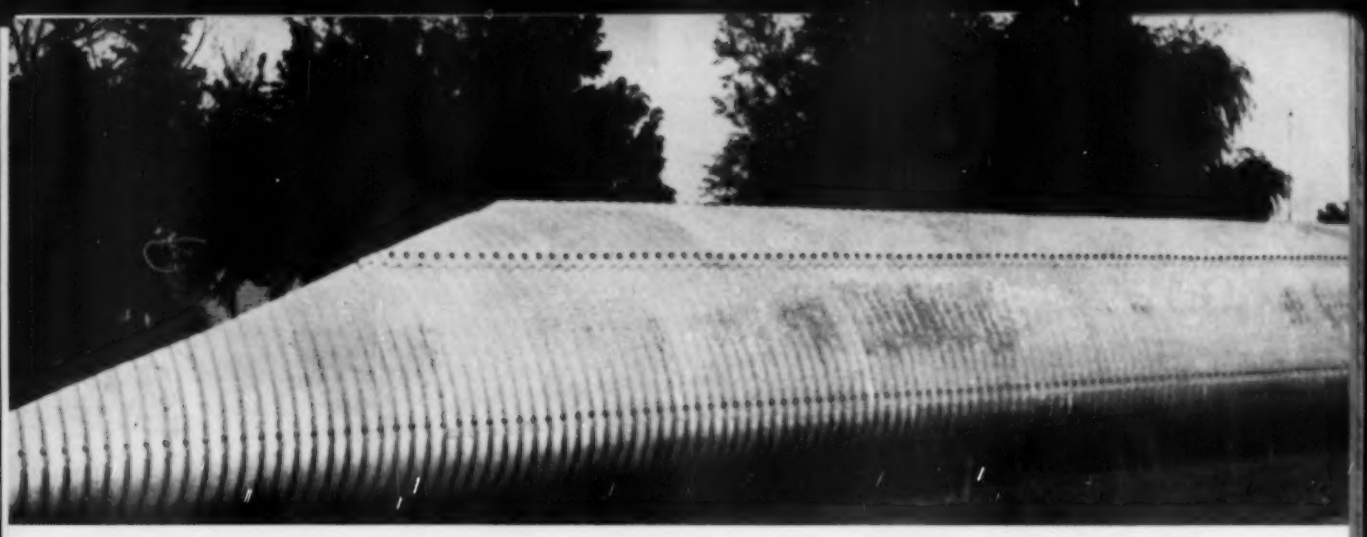

This 146′ Republic Sectional Plate Pipe-Arch was . . .

ASSEMBLED IN FOUR DAYS!
INSTALLED IN 2½ HOURS!

A six-man crew completely assembled this 146′ sectional plate pipe-arch in four days. Installation required just 2½ hours. Results: big savings in time and money, earlier project completion, minimum construction traffic tie-ups.

This job report from Fond du Lac, Wisconsin, is typical of Republic Sectional Plate Pipe-Arch performance. Engineered and fabricated at the factory, Republic drainage structures are delivered to you ready for assembly.

Simplified design eliminates the need for highly skilled labor or complex equipment. Other Republic fast-assembly features include: sections of optimum sizes for easy handling and erection, specially designed bolt that may be tightened from one side only.

For additional information on Republic Sectional Plate Pipe-Arch and other problem-solving drainage products, simply contact the Republic Drainage Products Manufacturer nearest you (see list at left), or mail coupon.

Manufacturers of Republic Drainage Products

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The Boardman Co.
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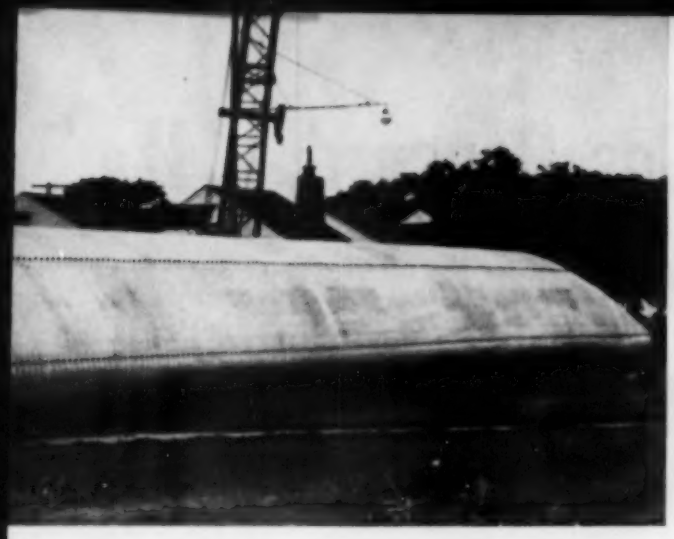
EASY PLACEMENT. After assembly on the shoulder of the highway, the 22-ton structure was lifted by cranes into the excavation. Total placement time—2½ hours. The pipe-arch, which replaced a concrete bridge on East Johnson St., Fond du Lac, Wisconsin, was made of 8-gage corrugated sectional plate and measured 10′11″ wide by 7′7″ high.



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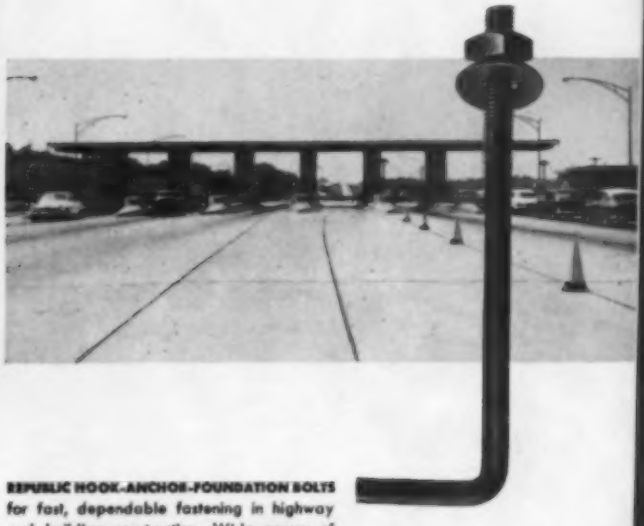
REPUBLIC PLASTIC PIPE IN AIR CONDITIONING—2″, 1½″, and 1″ Republic SRK (Semi-Rigid Plastic Pipe) was selected for condensate return lines on 652 American Blower Fan Coil units that were recently installed in a Cleveland, Ohio, hotel. According to Becker-Seidel-Clark, plumbing contractors, plastic pipe was specified because it could be installed several times faster in a job of this type. Return coupon for details.



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Sanitary landfill helps Concord, N. H.,

Caterpillar No. 955 Traxcavator

Here you see the benefit of sanitary landfill to Concord, N. H. Sanitary landfill eliminates odors, insects and vermin. It eliminates the cost of sorting refuse. It costs less than incineration and, best of all, the Caterpillar equipment used for this operation can be used for other city work. Many cities are turning to sanitary landfill to get a cleaner city and to turn waste land into useful, salable property.

get a new park . . . a cleaner city

handles 3,600 yards of refuse per month

The old city dump in Concord, New Hampshire, is a thing of the past. In its place is an attractive new city park (shown below) and a sanitary landfill (left) that will eventually become a valuable industrial site. Every one of the 28,000 citizens of Concord will benefit from this modern way to handle refuse.

Key to the success of the landfill operation—which covers an area of approximately four acres adjacent to an industrial area—is the Caterpillar No. 955 Traxcavator which does the work. It is a 1½ cu. yd. 70 HP machine that is designed for quick, easy operation and fast cycle time. It handles 3,600 cubic yards of refuse a month. Total cost to the city of Concord for the sanitary landfill is only $0.94 per person, per year. Costs of the entire refuse disposal operation—pickup trucks, administration, wages, etc.—come to only $3.65 per capita, annually.

There are three Traxcavators in the Caterpillar line—the No. 933 (52 HP, 1⅛ cu. yd. bucket capacity), the No. 977 (100 HP, 2¼ cu. yd.) and the No. 955 which is being used so successfully at Concord. All three can be equipped with the exclusive Caterpillar side dump bucket. And all three can handle many more jobs—excavation, fill, snow removal, loading, street and alley work.

Your nearby Caterpillar Dealer can give you complete facts on the economics of sanitary landfill with Caterpillar machines. He's always handy when you need parts or service and he can help you select the right machine. Get in touch with him.

Caterpillar Tractor Co., Peoria, Illinois, U.S.A.

At Concord, N. H., refuse is dumped, compacted and covered lightly. When a layer six feet thick has been put down, a two-foot layer of soil is spread over it. Concord picks up refuse in residential areas once every two weeks . . . in business areas off Main Street, once every week . . . on Main Street, once a day.

CATERPILLAR

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YOUR TAXPAYERS GET THEIR MONEY'S WORTH WITH CAT-BUILT MACHINES

Greenville, Miss. Cuts Costs . . . Improves Refuse Collection with DUMPMASTER

Officials, Merchants Enthusiastic Over New Type Service

After five months of operation, Greenville, Mississippi officials, merchants and sanitation department employees believe their DEMPSTER DUMPMASTER system is the answer to low-cost, sanitary refuse collection.

This prosperous, progressive city on the banks of the Mississippi River installed one truck-mounted Dumpmaster and 39 containers in sizes ranging from three through six cubic yards in February of 1959. Five months later, City Engineer John Teunisson who, together with a far-sighted city council instituted the installation, reports that the new system has exceeded his highest expectations for economy and efficiency.

Members of the Sanitation Department who have closely supervised operation of the new equipment are particularly pleased with the Dumpmaster's ability to handle big capacity containerized refuse, as well as hand-loaded residential pickup routes. It is pointed out that this flexibility enables them to keep the equipment busy, thereby saving the taxpayers money.

John Teunisson, veteran city official, likes Dumpmaster economy.

Dumpmaster picks up 6 cu. yd. container behind elementary school.

Schools and Downtown Areas Containerized Residential Routes Served By Dumpmaster

At present, schools and the downtown business district, where large volumes of refuse accumulate, are served by big capacity containers, with all 39 locations being given daily service. Additionally, several manual loading routes in residential areas are served by using the Dumpmaster as a conventional packer truck.

City Engineer Teunisson estimates that the school containers will pay for themselves in less than one year as a result of time savings with the new system. The Dumpmaster has made possible a $7,000 reduction in the Sanitation Department Budget. The size of these savings and opportunities for further improvement have led Greenville to set up a goal of over 100 containers as soon as expansion funds become available.

Typical installation behind a store in the downtown business district of Greenville.

Tax-Fee Plan Covers Expenses

Greenville's residential and school refuse collection is tax supported, but commercial refuse carries a charge to the merchant based on the time necessary to make a pickup with a conventional packer truck and its crew. The monthly charges are based on the number of pickups, times the number of minutes required, times $2.75 per minute. These proceeds are applied to pay for the container, the Dumpmaster and the operator's salary. Because of the high speed collection, the city saves enough over manual operation to offer free service to any merchant who purchases his own container.

Dumpmaster dumps huge load at the efficiently operated landfill.

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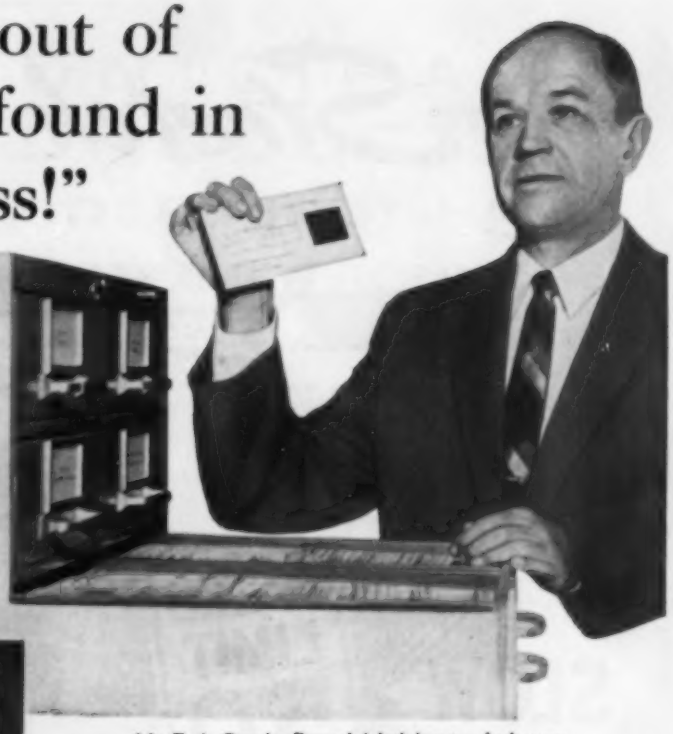

Mr. F. A. Cerwin, Record Administrator, looks over Recordak Microfilm file, now the *active* drawing file for Cook County Highway Department

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ST. LOUIS 23, MISSOURI

FEBRUARY, 1960

PUBLIC WORKS Magazine

VOLUME 91
NUMBER 2

MUNICIPAL HYDROLOGIST PROVIDES FIRST-HAND DATA ON WATER SOURCES

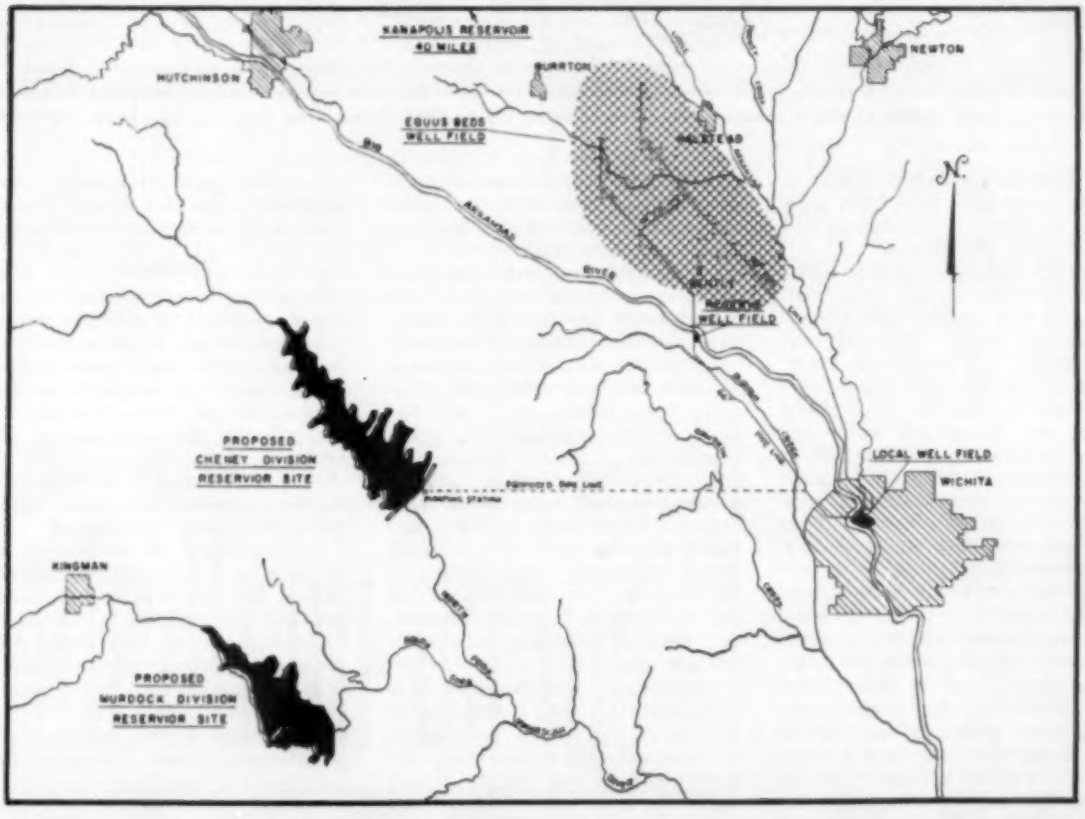
G. J. STRAMEL, Hydrologist, City Water Department, Wichita, Kansas

RETAINING a hydrologist is a unique feature of the Wichita, Kansas, water department. The hydrologist works as a staff member in the departmental organization keeping the director informed of the day-to-day and long-range problems of water supply. In accomplishing these objectives the hydrologist has the cooperation of other operating divisions, in particular that of Production and Purification. The position requires that full time be spent on investigations of present and future water supply problems.

The position is classified by the Personnel Division as supervisory and professional engineering for the purposes of research investigation of sources of water supply, inspection of new well construction, and study of geology and the feasibility of artificial recharge of aquifers. The hydrologist must be a graduate civil engineer or geologist and have extensive knowledge of principles, practices and equipment used in water supply and production.

The Water Department has recognized that eventually all water sources in South Central Kansas will be considered for development, requiring considerable antecedent basic water facts. Quantity and quality considerations will determine, in large part, which sources will be developed by the City. At the present time the City's supply consists of 55 wells located some 25 miles northwest of the City in what is commonly called the "Equus beds." The City also maintains and uses 30 wells located in the

● FIGURE 1. Location of present water sources and future potential water sources for Wichita, Kansas.



filter plant area within the City. The aquifer supplying local wells is hydraulically connected to the Arkansas River and provides water of only fair to poor quality because of the variable characteristics of water contained in the Arkansas River. The City has been working in cooperation with the Bureau of Reclamation to develop a surface reservoir on the North Fork of the Ninnescah River some 24 miles west of the City for supplemental supply. Two separate bills have been submitted to Congress requesting authorization of the project.

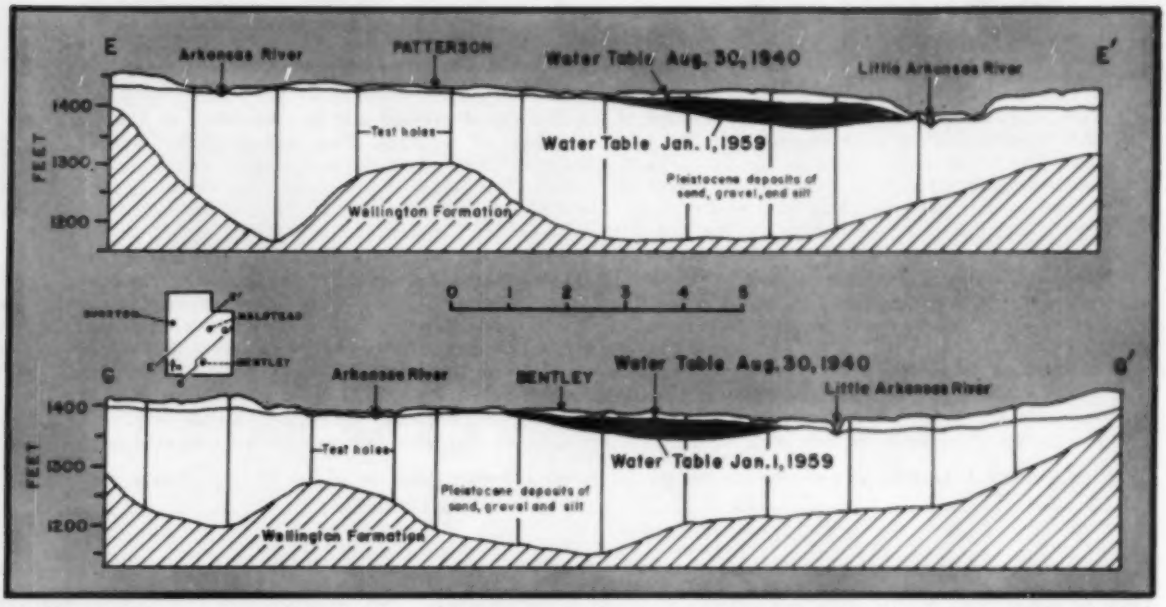
From the population growth curve and a corresponding water use curve, the City realizes that at some time in the future additional raw water supply will be needed. Thus, it becomes necessary to review and study all possible surface water sources and all ground water resources in the area. The South Fork of the Ninnescah River would provide a considerable quantity of water but of only fair quality. The Little Arkansas River can furnish a supplemental supply of good to fair quality while the Arkansas River, although used as a source of supply through river wells during peak demand periods, leaves much to be desired qualitywise. A basic difficulty confronting the development of a surface source is the lack of suitable reservoir sites in the relatively flat country of South Central Kansas. For the most part, surface water quality and quantity studies are being made in order to supply us with data to enable us to determine stage-quality relationships. It will allow us to predict what percent of the time the water might be of acceptable quality to facilitate supplemental direct use of the surface sources.

The original 25 wells in the Equus beds well field were constructed in 1939 and 1940. They are slowly wearing out and will need to be replaced. The replacement of these wells is being done under the supervision of the hydrologist and the water superintendent.

Considerable research has been done in the Equus beds well field to determine the hydraulic coefficient of transmissibility of the aquifer and the related determination of individual well efficiencies. Too many times in the water well industry every consideration is given to efficiency of meters, pumps, etc., but little or no effort is made to measure the efficiency of a most important facet of the industry, and that is the well itself. It is believed that a reasonable determination of efficiency of a well can be made as this will tend to improve construction methods resulting in a more efficient operation.

Considerable geologic research is conducted each time a test hole or well is drilled. Much information has been collected through the years which aids in the design of new wells. In most cases drill cuttings are saved and a cut made for the State Geological Survey to aid in the areal geological studies being made.

Continuous studies are made in the Equus beds well field in order to note the rise and fall of the water table. Some 200 observation wells are maintained to note the stage of the underground reservoir at all times. These measurements are made also to allow computations of natural recharge. Complete pumping records are maintained at all of the production wells. Accordingly a good job of water bookkeeping has been made for 19 years.



● **FIGURE 2. Cross sections of the Wichita well field area showing the lowering of the water table between 1940 and 1959.**

Recharge

Development of methods to increase recharge by artificial means is another of the duties assigned to the hydrologist. Much underground storage space is available in the Equus beds well field. A cross-section showing the thickness of the aquifer and the dewatered part of the aquifer is shown in Figure 2. At the moment four major categories are being investigated.

One method of recharge is through wells using surface run-off water. The results so far have been negative and probably will continue to be negative but such results beg the question, why do the tests at all? It is remarkable how many people believe that all one has to do is run surface water down a well to effect a recharge program. This is not the case and it is considered worthwhile to collect a set of data to show how rapidly wells actually plug. It will

be necessary to determine if it is physically and economically possible to use wells as recharge units. A study whereby surface run-off water will be recharged into a dewatered formation through a shallow surface pit exposed to the aquifer gravels is now in progress. No results can be reported at this time. The City's well field zone of influence covers an area of about 100 square miles. A high rate of recharge occurs naturally, and at least 10,000 acre-feet of water escapes the well field area annually. Considering these facts, it appears that the most promising method of artificial recharge will be the practice of good soil and water conservation on the land itself. This, of course, is a big project and should be twofold. First, good soil and water conservation practices can be a real benefit to landowners and certainly can be justified on that basis alone. Second, the effect of good soil and water conservation practice will increase the insoak time and consequently increase recharge over the whole area. Some measure of control will be needed in regard to drainage, flood control, and road ditches. Cooperation will be needed between townships, counties and landowners because of some of the contradictory practices of water management. A good program can be worked out and it appears the geology of the area is well suited for development of a model watershed area.

Another form of artificial recharge under investigation contemplates induced recharge along both the Little Arkansas and the Arkansas Rivers. The point here is to let the river, during periods of sufficient quantity and acceptable quality, provide the recharge to wells placed adjacent to the river. Good hydraulic communication has already been proven along the Arkansas River and at one place along the Little Arkansas River. A more comprehensive study concerning pumping and test drilling is currently in progress along the Little Arkansas River. Our intentions here are to see if there is a hydraulic connection between the river and the aquifer, and to see if there is any variation in efficiency of hydraulic connection at various stages of the river. It may be that good water communication will be possible during high flow and only fair communication at low flow. Basically this approach is a conservation measure because it deals primarily with water which is going to waste unused.

Quality Studies

Variation in flow, chemical quality sediment load, and methods of development of the Little Arkansas River have been investigated to a considerable extent. Much more research concerning this resource is needed, particularly as to what might be done in the upstream watershed and in pollution control.

Studies in the future will be concerned with diversion of surface flow into the dewatered area of the well field. Theoretically the dewatered zone of the well field has a high potential for storage providing water can be led underground during periods of surplus surface water. This, of course, envisions a fluctuating water table to be lowered in times of drought and filled during periods of surface run-off. This, too, will require the utmost in area cooperation, the lack of which is probably one of the biggest problems facing an artificial recharge and conservation program. Practically all of the land in the well field is privately owned, and without landowners' cooperation a program of conservation is greatly hampered.

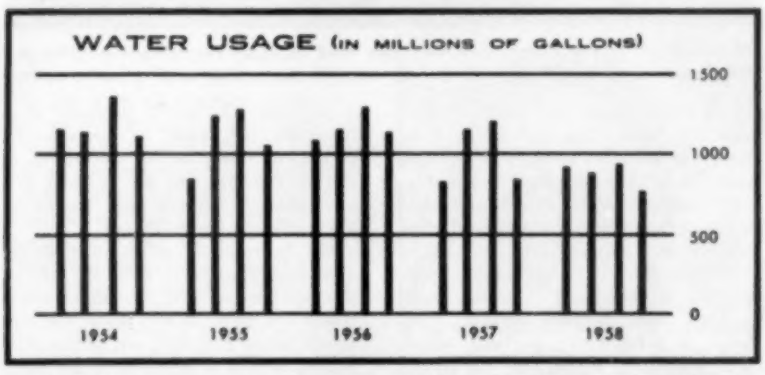
In the Equus beds well field area where the water table has declined below the domestic users' shallow wells, the City has recognized the damage it has done to domestic water rights and accordingly deepened the farmers' wells and supplied them in most cases with electric pumps. Much research is being done with quality-of-water problems in farm wells, particularly with high iron. For the past year the City has used plastic well casing for farm wells exclusively and the results of our findings will be published at a later date. At this point, plastic well casing has functioned satisfactorily to depths up to 115 feet. Inasmuch as each time a new well is drilled the test hole provides additional geological information, these functions also fall under the hydrologist's duties in cooperation with the water superintendent and the well field supervisor.

The pollution threat from the Arkansas River and from some past oil field activities in the Burrton, Kansas, area is constantly observed under the supervision of the hydrologist. In this manner the City knows at all times the exact extent of the problem and should correction measures be necessary, they can be taken quickly.

The City of Wichita maintains cooperative studies with the State Geological Survey and the U. S. Geological Survey and all the current studies are done with their assistance when needed. Studies of ground water, sedimentation, and surface water flow are conducted by the respective agencies. The hydrologist's duties include working in close liaison with the various cooperating agencies.

All of the work and research findings by the hydrologist will be reported for future reference. Most of the information will eventually be published. Thus the data and findings will be catalogued and filed. This is an important function of the position as it is common for much useful data to be slipped into files and forgotten.

The common exchange of ideas and findings between investigators in other cities and governmental agencies should be one of the most important duties of any technical staff member of any water department. The position of hydrologist allows the City to have firsthand day-to-day knowledge of its water resources and allows it freedom to pursue some of the research problems which face the Water Department. As pointed out in the beginning of this article this is a somewhat unique position but one that the City considers beneficial, particularly for future planning.



● **RECORD of water usage for the months of June to September, Wichita, Kansas.**

● STRIP 2 ft. wide is placed along the shoulders to widen the traveled way.

Knowing that we had a good supply of the waste screenings which contain sufficient binder to be stable, we decided to use this material on our berms. In 1958 a Model 605 Power Pack hopper conveyor was purchased by the County. The machine is used to apply waste screenings in a strip 2 feet wide on both shoulders of newly surfaced bituminous roads. The material is applied 1 inch above the edge of the pavement; our 2-ton patch roller follows up with one-half of the roll width on the pavement and the other half on the screenings. To prevent erosion on grades we have made it a policy to apply 0.5 gallon of MC-1 liquid asphalt on the shoulders where the highway grade exceeds

SURFACE SHOULDERS ON BITUMINOUS ROADS

W. W. ANDERSON
Medina County Engineer, Medina, Ohio

TO ELIMINATE a hazardous condition caused by low shoulders at the sides of our bituminous surfaced county roads we have undertaken a program which provides durable, compacted shoulders. This has been accomplished on a limited budget by county forces and equipment, and has made use of what was formerly considered waste material.

Medina County, located in northern Ohio, adjoins Cuyahoga County and the City of Cleveland on the north and Summit County and the City of Akron on the east, a situation which results in moderately heavy traffic. Our county highway system of 352 miles is 70 percent black top and 30 percent gravel. All roads are graded to the same standard cross-section. Nearly all of them have pavement widths of 18 feet with 4-ft. shoulders, or 26 feet from berm to berm. Periodically the black top surfaces are leveled and strengthened by the addition of 1 to 2 inches of bituminous concrete or bituminous road mix, an operation which results in low and dangerous shoulders.

Years ago Medina County purchased 35 acres of land and operated a dry screened gravel plant at the site until the gravel was exhausted five years ago. During the period of gravel production the

● CLOSE-UP of the Power Pack Conveyor used to apply the screenings. This is followed by 2-ton patch roller. On grades over 2%, an asphalt application is made.

screenings, ½-in. and under, were dumped back into the excavation. Recently we have used these screenings for bridge approaches and culvert backfill and have found that they contain enough silt and clay binder to compact very well. Also, when applied in 4 to 6-inch compacted courses on gravel roads, primed and surface sealed, they form a satisfactory surface which will withstand traffic and the spring breakup.

2 percent. The crew consists of a foreman, two men to operate the conveyor, one man on the roller, a shovel operator at the gravel pit, and enough drivers and trucks to keep the conveyor in use.

We bermed 35 miles of road in 1958 and 32 miles in 1959. By adding the two feet on both shoulders, these roads are now 22 feet wide and are much safer. The turn out at the mail boxes, which is a problem in itself, is taken care of also.

STANDARDS
FOR STORM WATER FACILITIES

THE Metropolitan St. Louis Sewer District has established new standards for storm water ditches in order to reduce erosion, to lower maintenance costs and to provide engineers and builders with definite data for storm sewer and ditch design. The new standards provide, in brief:

1. Existing stable banks are not to be disturbed.

2. Channels in soils of high erosion resistance may remain unlined unless hydraulic capacity requires paving.

3. Auxiliary swales (side ditches) — either paved or sodded — and sodded berms at the tops of banks are to be provided to help arrest erosion from the top of the channel. Swales and berms are to be built on both sides of the channel, each a minimum of 4 ft. wide.

4. Minimum required right-of-way on each side of the channel is to be 15 ft., including berms, to provide access for maintenance.

5. No fences are to be placed within the limits of the ditch easements.

Fig. 1 shows a typical cross-section of a storm water channel. The bottom width W is determined by design flow requirements. S is the horizontal projection of the channel side slope to the top of the bank. The slope is 1 vertical to 1½ horizontal for paved channels; 1 vertical to 2 horizontal for sodded channels; and 1 to 2½ for a seeded channel. Where unstable earth is present, the required side slope may be flatter.

Assigned velocities which should not be exceeded are as follows for erodible materials: Non-colloidal fine sand or sandy loam, 1.5 fps; non-colloidal alluvial soil, 2.0 fps; fine gravel or firm loam, 2.5 fps; colloidal stiff clay or alluvial silts and non-colloidal graded loam to cobbles 3.75 fps; colloidal graded silt to cobbles or non-colloidal coarse gravel 4.0 fps; cobbles and shingles 5.0 fps; and shales and hardpan 6.0 fps.

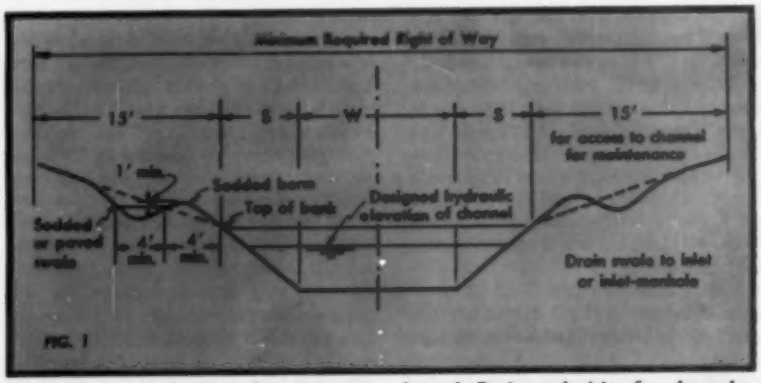
Fig. 2 shows a typical paved section. The paving is reinforced with wire mesh at 30 lbs./sq. ft., using 6-in. mesh. Paving drains must be installed draining to the channel through porous concrete or weep holes at the toe of the slope. Inlets may be provided for the side ditches to carry the side flow to the channel without causing erosion. A side sewer discharging into the stormwater channel enters through a manhole or inlet with a pipe having an angle of 30° to 45° for discharge into the channel.

Where a line discharges into an unpaved channel, a corrugated pipe is used to extend the line to a suitable point at the flowline of the channel. An inlet or manhole is required near the junction. The corrugated pipe is replaced with concrete when the stormwater channel is paved. Channel paving or bank paving or both may be required in otherwise unlined channels to prevent erosion at curves or at points of discharge of large flows.

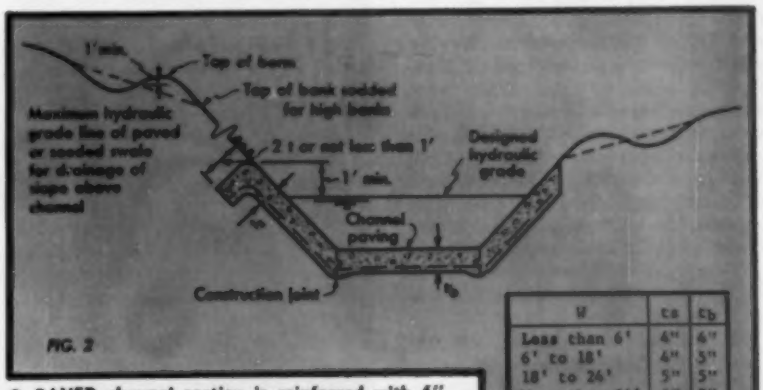
Swale paving is required where velocities in the side ditches exceed 5 fps. Cut-off walls are provided at ends of paving to prevent undercutting and failure.

The problem is primarily one of controlling storm water runoff. Originally, sink holes and ditches were used. As the area around St. Louis developed and impervious surfaces increased, the old methods were no longer sufficient. Moreover, problems arose with real estate developments in which the developer was usually unable to provide for storm water from adjacent areas and to discharge the water collected by whatever system he installed into any planned system for disposal. The new standards represent the latest steps to ameliorate these conditions.

William Q. Kehr is executive director of the MSD.

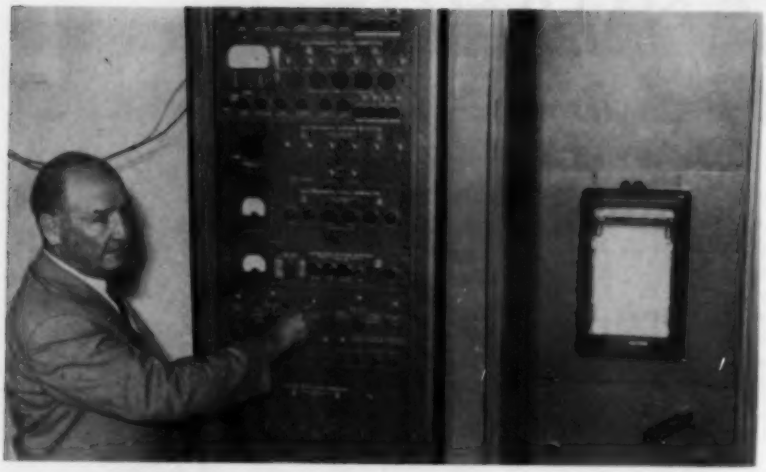


● **TYPICAL cross-section of a stormwater channel. Design velocities for channels in erodible materials vary from 1.5 to 6 feet per second, depending on the material.**


1' min.
Top of berm
Top of bank sodded for high banks
Maximum hydraulic grade line of paved or seeded swale for drainage of slope above channel
2 : 1 or not less than 1'
1' min.
Designed hydraulic grade
Channel paving
Construction joint
FIG. 2

W	t_s	t_b
Less than 6'	4"	4"
6' to 18'	4"	5"
18' to 24'	5"	5"
More than 24'	6"	7"

● **PAVED channel section is reinforced with 6" x 6" welded wire mesh. Drains and rock or gravel filled pockets are provided as needed.**



● MASTER control computes the volume rate of traffic flow and automatically puts the desired cycle into effect.

OPERATION OF AN ELECTRONIC

DAN J. MURRAY,

Superintendent of Maintenance, Essex County Highway Department, Livingston, New Jersey

BLOOMFIELD Avenue is an arterial route extending from the edge of the downtown area of Newark in a westerly direction through the towns of Bloomfield, Glen Ridge, Montclair, Verona and Caldwell. It is one of the more important radial routes carrying traffic between the city and surrounding suburban towns and is maintained, even within Newark, by the County of Essex.

The traffic situation on Bloomfield Avenue in 1957 indicated the need for a more flexible traffic signal system than the single-dial, single-offset equipment then being used. Daily traffic volumes had climbed steadily over the years and were approaching 25,000 vehicles per day. Traffic varied considerably during the typical week-day. During the morning peak traffic hour, eastbound traffic toward Newark amounted to about 1,200 vehicles per hour with only about one-half that much traveling in the outbound or westbound direction. The flow reversed itself during the late afternoon peak traffic hour. Volumes during the midday period were quite evenly distributed in the two directions.

It had been necessary to operate the old single-dial, single-offset equipment on a 90-second cycle in order to provide capacity that was needed during the peak hours. This cycle length was much too long for the light traffic hours. The unbalanced traffic flows during the peak hours obviously demanded preferential treatment in timing the traffic signals.

After studying the various types of modern control equipment that might be used, the Electro-Matic PR System manufactured by Automatic Signal Division, Eastern Industries, Inc. was selected. The essential features of this system include the following:

1) Traffic sampling detectors are used to detect vehicular movements in the two principal directions and provide the master control at all times with information on the comparative volumes of traffic.

2) The master control computes the volume rate of traffic flow in each direction from the impulses sent in by the detectors and automatically puts into effect the cycle length that has been chosen for each level of traffic volume. It also selects an offset plan to fit the traffic conditions on the basis of the comparative directional traffic volumes.

3) Local intersection controllers operate within the cycle length and offset plan selected by the master. Each controller has timing dials that are used to set the apportionment of time between the two intersecting streets and also the clearance intervals for pedestrians and vehicles in accordance with the characteristics of each intersection.

4) Multi-conductor cable was selected to interconnect the master control with all intersection controllers. Cable was chosen over a radio interconnect system because of the availability of ducts along Bloomfield Avenue.

A system of twenty-one signalized intersections was planned, covering 3.2 miles from Broadway in Newark to Ward Street in Bloomfield.

Radar vehicle detectors were installed to sample the traffic flow. Each direction of traffic was sampled at two locations, one where the traffic first entered the system and the other near the middle of the system.

Detector impulses from both of the inbound locations are transmitted to the master control via separate pairs of wires in the interconnect cable and fed into the inbound cycle computer. This unit constantly computes the rate of traffic flow on the basis of the number of detector impulses received during a short period of time and indicates the volume at any moment as a percentage of a reference volume. This volume is adjustable by means of a dial on the computer and is selected so that a 100 percent reading is obtained during the peak hour. Five other dials on the cycle computer are used to select percent values between 0 and 100 at which the various cycle lengths will be put into effect.

The two outbound vehicle detectors are associated with the outbound cycle computer in the same way. The two computers operate completely independently of each other, each calling for a cycle length appropriate to the traffic volume in the associated direction.

A third unit in the master control is the system selector. This unit compares the two cycle lengths being called for by the cycle computers and always selects the longer of the two for use as the system cycle length. It also compares the two cycle lengths on the computers to determine which offset plan should be in effect. When both computers are calling for the same cycle length or for cycle lengths not more than one step apart, the system selector puts the signal system

TRAFFIC SIGNAL SYSTEM

on the average offset plan. When the two specified cycle lengths are two or more steps apart, the system selector calls for the preferential offset plan designed to favor the direction of the heavier traffic volume. Each local controller has three separate offset dials, inbound, outbound and average. Each can be set for any percentage offset between 0 and 100 as determined from time-space diagrams.

A cycle generator unit in the master control has six dials that are used to select the values for each of the cycles. For example, Cycle A, the shortest cycle, can be set for any desired value between 40 and 75 seconds. Cycle F, the longest cycle, can be set for any value between 65 and 120 seconds.

A valuable "watch dog" unit in the master control is called the system supervisor. It constantly monitors the output of the master control and guards against almost any conceivable malfunction that would affect the operation of the local controllers. Should certain units in the master control fail to put out the necessary information to control the cycle length at the local controllers, the system supervisor will place the entire system on a fixed 80-second cycle. In the event of failure in other master control components that would prevent the 80-second cycle from going into effect, the system supervisor would free all local controllers from the master control and place them on isolated operation. This is a stand-by operation requiring only local power at each intersection controller. A synchronous motor unit in each of the PR Locals produces a fixed-time non-interconnected type of operation until the master control is back in service. This type of operation can also be used during installation of the system until such time as the master control and cable interconnect is completed.

Model PR-3 local intersection controllers were selected for the majority of the intersections. This controller provides two traffic phases and a third phase suitable for an exclusive pedestrian interval. The pedestrian interval can be controlled at the master and inserted in the cycle during any desired hours of the day. The WALK interval can also be included at all times or omitted at all times at any particular intersection. We are not using the exclusive pedestrian interval at the present time but it is available at all intersections and can be brought in when needed.

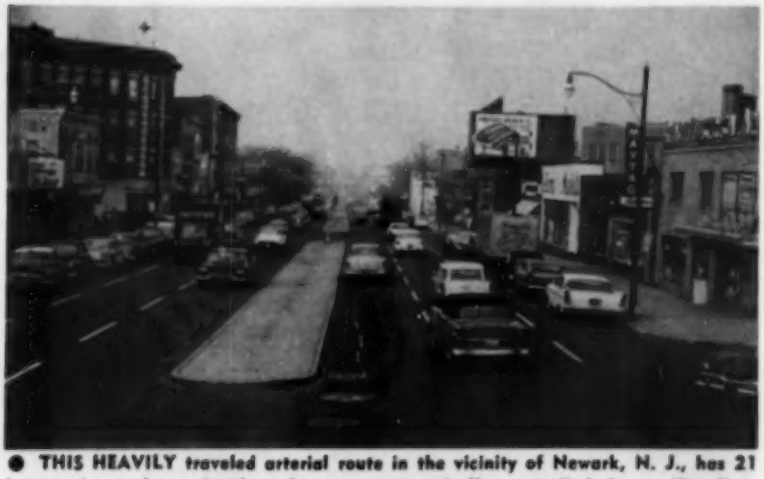
Three-phase traffic operation was necessary at the intersection of Bloomfield Avenue with Park Avenue and High Street where a Model PR3-2 controller was installed. Model PRA-3 three phase semi-actuated controllers were installed at two intersections where side street traffic was very light and Bloomfield Avenue traffic had to be interrupted for pedestrian movements which were heavy during only a few hours of the day. One of these is at a school crossing and the other at a rather isolated shopping area. When there is no demand for the side street phases at these two intersections, the green light can remain indefinitely on Bloomfield Avenue. The third phase of these controllers is available for use as an exclusive pedestrian phase, should it be needed.

One interesting feature of the new system is the telephone circuit which has been incorporated. The master control includes a bell and head set and plug-in type telephones are carried by the signal crews. Whenever a serviceman wants to make adjustments in a local intersection controller, he simply plugs in his telephone to a jack in the controller cabinet and rings the master over a pair of wires in the interconnect cable. Anyone on duty at the master can then manually change the cycle length or the offset in accordance with the needs of the man at the intersection. Our crews find this feature very useful and we feel that it has paid for itself during the first few weeks of operation when many minor adjustments had to be made.

Maintenance of this system is accomplished by the Traffic Signal Division of the Highway Department. A daily inspection of the master control equipment is made to observe if all visual check points are in order. Two Esterline-Angus graphs are in constant use, providing the Traffic Engineer with continuous permanent data on traffic volumes for every minute of the day and night. Any changes in dial settings on the master unit are a result of the information from these graphs. A periodic inspection every four months will be made to test the electronic tubes so that any showing diminishing values may be replaced before a failure occurs.

A daily schooling program of one hour is conducted by the supervisory personnel of the Division. This was supplemented by three days of "on the spot" schooling by factory representatives from the Automatic Signal Division. Actual field break-downs were created and cleared, enabling the maintenance men to observe what could happen and how to correct such failures. This daily schooling continues throughout the year in an effort to keep the personnel abreast of the new developments in the ever expanding field of traffic control.

The special appropriation fund for the purchase of the electronic equipment was from capital expenditures, amounting to $51,775. All other expenses incurred were from budgetary items. The total cost of this installation was $65,525.



● **THIS HEAVILY** *traveled arterial route in the vicinity of Newark, N. J., has 21 intersections where signal cycles are automatically controlled by traffic flow.*

COUNTY TREATMENT PLANT for INDUSTRIAL and MUNICIPAL WASTES

WIN TEMPLETON,
Templeton and Linke,
Consulting Engineers,
Salt Lake City, Utah

THE North Davis County Sewer District comprises portions of Davis and Weber counties in northern Utah, an area of some 50,000 acres. Installations served include eight municipalities, Hill Air Force Base, employing in excess of 10,000 workers, and the Clearfield Naval Supply Depot, employing approximately 1,500 workers.

The District is in an area that has experienced a rapid population growth, from 5,677 in 1940 to a present estimated figure in excess of 26,000. The assessed valuation of the District has increased from $12 million in 1948 to over $20 million at present.

The sewer district was created in 1954 to take over an existing sewerage system that provided no treatment, but discharged raw sewage to the Great Salt Lake. In May, 1955, the District authorized the sale of $2,900,000 in bonds to expand the system and to construct a treatment plant to handle the sewage from the total area.

After a thorough study of the requirements, it was determined that a two stage, high rate filter plant should be constructed. The master planning for the District was based upon an ultimate population of 225,000. The initial plant was designed for a flow of 9.5 mgd, and an equivalent population of 74,500, including 32,500 industrial equivalent population. Design was based upon a raw sewage content of 150 mg/L BOD and 105 mg/L suspended solids.

The municipalities and the military depots install and maintain their own sewage collecting systems, which discharge to the District outfall mains. Garbage disposal units are being installed in many of the new housing units, so that heavier plant loading may be expected in the future.

Hill Air Force Base contributes approximately one mgd of industrial and sanitary wastes. The Base does have an industrial waste plant through which most of their industrial wastes pass; however, there are three outlets from the Air Force Base and some untreated industrial wastes reach the District sewer directly. The Naval Supply Depot is primarily a warehousing operation and its industrial waste load is not heavy. There have been some oil and chemical wastes released from Hill Air Force Base in excess quantities; however, this condition is rapidly being corrected.

There are four large canning factories and two small meat packing plants located within the District. The canneries process principally cherries, apricots, peas, beans, corn and tomatoes. They are required to pretreat their waste with a fine screen or a comminutor. The meat packing plants are prohibited from dumping paunch manure, blood or excessive quantities of grease to the sewer. To date, no great difficulty has been experienced with the wastes from either industry. The balance of the industrial load is normal commercial and light industrial wastes originating in the several municipalities. The sewer system does not carry any storm water and, therefore, the load to the plant is fairly constant.

The construction of the plant was contracted to Davis and Butler Construction Company in May, 1957. The construction cost of the plant was $1,310,000, a population equivalent per capita cost of $17.60.

Plant Description

The raw sewage flow, at present, is averaging about 6.5 mgd. It enters the plant through a mechanically cleaned screen, equipped with grinder, thence through a grit separator to a pumping station, which houses both the primary and secondary pumps. This combination

● **AERIAL VIEW of the treatment plant of the North Davis County Sewer District. Present design capacity is 9.5 mgd, with provision for considerable future expansion.**

pumping station has been planned to provide capacity for the ultimate requirements of the District. The initially installed equipment for the primary pumping station and the secondary pumping station are of equal capacity, each station having one variable speed drive and two constant speed pumps.

The primary pumping station delivers the raw sewage to the primary clarifier. The sludge from the intermediate clarifier and final clarifier are returned through the primary pumping station to the primary clarifier so that all sludge is pumped from the primary clarifier to the digesters.

The effluent from the primary clarifier is conveyed to the primary filter which is 150 ft. in dia. with a 6.5-foot average rock depth. The filter media is river washed quartzite gravel, graded between two and three inches in size. The effluent from the primary filter goes to the intermediate clarifier. The return of sludge from this clarifier is controlled through a valved line, equipped with a sight glass.

● **FILTERS are high rate, with an intermediate clarifier. The maximum hydraulic loading on the primary filter is 42.6 MGAD and on the secondary filter 45.6 MGAD.**

TABLE 1—PLANT OPERATING RECORD

	Monthly Averages		
	June	July	August
Raw Sewage Flow, MGD	5.6	6.1	6.5
Grit Removed cu. ft./day	2.9	5.1	3.7
Flow applied to filters, MGD	6.3	7.4	7.4
Digester Temperature, Deg. F.	92.2	91.5	92.1
Gas Production cu. ft./day	31,018.0	33,989.0	41,390.0
FIVE DAY BOD,mg/L			
Raw Sewage	109.0	117.0	102.0
Primary Effluent	34.0	16.1	18.0
Final Effluent	9.0	8.7	9.8
SUSPENDED SOLIDS, mg/L			
Raw Sewage	116.0	110.1	102.0
Primary Effluent	27.0	21.4	31.5
Final Effluent	1.3	1.6	8.0

The effluent from the intermediate clarifier enters the secondary pump station and is lifted to the secondary filter which is 145 ft. in dia. with 5-foot average rock depth. The media in this filter is also graded from two to three inches.

Two digesters are provided, operated in series, the primary having a floating cover and the secondary, a gas holding cover. The digesters were placed in operation without seeding and were producing sufficient gas to provide their own heating requirements within three months.

There are twelve sludge drying beds with a total area of 115,000 sq. ft. The under drainage from the beds is returned to the primary pumping station for recirculation through the plant. Two chlorinators are installed in the pumping station, with provision for chlorination of raw sewage intermediate chlorination and chlorination of the final effluent.

Table 1 has been compiled from laboratory reports maintained at the plant; twenty-four hour composite sampling has been conducted on an average of six times per month or more.

The returning of sludge from the intermediate and final clarifiers through the primary pump station to the primary clarifier has aided materially in obtaining the high removals in the primary clarifier. It also resulted in a material saving in capital outlay by reducing the

number of sludge pumps and length of sludge lines required. In the three months operating record shown in Table 1, nearly all types of cannery wastes were received, with fruit wastes in June, peas and bean waste in July and tomato wastes in August. The pH throughout the plant has remained favorable without the use of any chemicals, and the dissolved oxygen in the final effluent has remained very high considering the wastes being handled. This, we believe, is attributable to the two stage filters and the use of well graded media. The District has plans to use the effluent for irrigation and industrial purposes.

The plant maintenance and operational expense for 1959 is budgeted at $49,000. This includes two-thirds of the District's total overhead charges.

The District is operated by a Board of Trustees, eight of whom are appointed, one from each of the municipalities, and one trustee is elected from the unincorporated areas of the two counties, making a nine man Board of Trustees. The affairs of the District are directed by Golden Layton, District Manager, and the Sewage Treatment Plant is under the supervision of Floyd Erickson, Chief Operator.

Summary of Design Bases and Major Equipment Used

COARSE BAR SCREENS

Types: 1 Mechanical—1 Manual with grinder
Manufacturer: Walker Process Equipment, Inc.
Size: 1" clear openings on mechanical screen
1⅝" clear openings on manual screen
Flow Capacity:
Mechanical Screen—23 cfs @ 2½ fps
Manual Screen—14.7 cfs @ 1 fps

GRIT REMOVAL UNIT

Type: Mechanical grit collector, inclined screw washer
Manufacturer: Process Engineers Div., Eimco Corp.
Size: Grit Collector, 22′ square
Grit washer—16" dia. double deck screws 43′ long
Grit Removal Capacity:
At 65-mesh removal, 19.0 MGD
At 100-mesh removal, 9.5 MGD

RAW SEWAGE PUMPS

Type: Horizontal centrifugal
Size: 4000 gpm, 60 hp; Fairbanks, Morse & Co.
8000 gpm, 100 hp; Aurora Pump Div.
Variable speed drive, flow range 4,000 gpm to 8,000 gpm, 100 hp; pump mfr. Fairbanks, Morse & Co.; drive mfr.; Eaton Mfg. Co.

PRIMARY CLARIFIER

Type: Center column supported mechanism
Manufacturer: Process Engineers Div., Eimco Corp.
Size: 135′ dia. x 7′ swd
Detention Period: @ 9.5 MGD, 1.9 hr.
Surface Loading: @ 9.5 MGD, 662 gpd/sq. ft.
Overflow Launders:
Type—Annular steel
Length of weirs—1200 ft.
Weir loading—per lin. ft. @ 9.5 MGD, 7900 gpd

PRIMARY FILTER ROTARY DISTRIBUTOR

Type: Reaction
Manufacturer: Process Engineers Div., Eimco Corp.
Size: 150′ dia.
Hydraulic Capacities @ 3.0 ft. max. head
Minimum flow—4,000 gpm
Maximum flow—12,000 gpm
Dosing Rates per acre per day:
Minimum flow—14.2 MG
Maximum flow—42.6 MG

INTERMEDIATE CLARIFIER

Type: Center column supported mechanism
Manufacturer: Process Engineers Div., Eimco Corp.
Size: 120′ dia. x 7′ swd
Detention Period: @ 9.5 MGD, 1.5 hr.
Surface Loading: @ 9.5 MGD, 838 gpd/sq. ft.
Overflow Launders:
Type—Annular steel
Length of weirs—1056 ft.
Weir loading, per lin. ft.—7950 gpd

SECONDARY SEWAGE PUMPS

Type: Horizontal centrifugal
Size: 4000 gpm, 40 hp; Fairbanks, Morse & Co.
8000 gpm, 75 hp; Fairbanks, Morse & Co.
Variable speed drive, flow range 4,000 gpm to 8,000 gpm, 100 hp; pump mfr., Fairbanks, Morse & Co.; drive mfr., Eaton Mfg. Co.

SECONDARY FILTER ROTARY DISTRIBUTOR

Type: Reaction
Manufacturer: Process Engineers Div., Eimco Corp.
Size: 145′ Dia.
Hydraulic Capacities: @ 3.0 ft. maximum head
Minimum flow—4,000 gpm
Maximum flow—12,000 gpm
Dosing rates, per acre per day:
Minimum flow—15.2 MG
Maximum flow—45.6 MG

FINAL CLARIFIER

Type: Center column supported mechanism
Manufacturer: Process Engineers Div., Eimco Corp.
Size: 135′ dia. x 7′ swd
Detention Period: @ 9.5 MGD, 1.9 hr.
Surface Loading: @ 9.5 MGD, 662 gpd/sq. ft.
Overflow Launders:
Type—Annular steel
Length of Weirs—1,200 ft.
Weir Loading, per lin. ft.—@ 9.5 MGD, 7,900 gpd

PRIMARY DIGESTER

Type: Floating cover with internal draft tube mixer
Floating Cover:
Manufacturer—Pacific Flush Tank Company
Size—85′ diameter
Internal Draft Tube Mixer:
Manufacturer—Process Engineers Div., Eimco Corp.
Mixing Capacity—15,000 gpm

DIGESTER SLUDGE HEATERS

Boilers:
Type: Hot water boilers
Capacity: Oil fired—810,000 Btu/hr. SBI net rating
Digester gas fired—1,350,000 Btu/hr.
Manufacturer: Kewanee-Ross Corporation
Heat Exchangers:
Type: Spiral heat exchanger
Capacity: 2 - 740,000 Btu/hr. each
Manufacturer: Dorr-Oliver Inc.

SECONDARY DIGESTER

Type: Gas holder cover
Manufacturer: Pacific Flush Tank Company
Size: 85′ diameter
Gas Storage Capacity: 50,000 cu. ft.

DIGESTER GAS CONTROL

Metering: Flow tube; Foster Engineering Div.
Recorder: Taylor Instrument Company
Flame traps, combination pressure relief and waste gas flame trap, waste gas burner, drip traps, pressure indicating gauge, low pressure check valve and pressure vacuum relief valves—Pacific Flush Tank Co. and Vapor Recovery Systems Co.

ELECTRICAL CONTROLS

Panel type motor control center in pump house and digester operating building.
Primary and secondary sewage pumps are controlled by electrodes which automatically vary the pumping rate through the variable speed drives.
Primary scum and primary sludge pumps are controlled by time clocks.
Supernatant transfer and sludge transfer pumps are manual. Sludge circulation pumps are controlled by thermometers in the digester. Starting the sludge circulation pump also starts the pump circulating water through the heat exchanger.
Clarifiers are manually controlled with overload alarm and cut-off.

SLUDGE PUMPS

Type: Horizontal nonclog sewage and trash pumps

Service	Primary Scum	Supernatant Transfer	Sludge Circulation
Number	1	1	2
Capacity	100 gpm	100 gpm	150 gpm
Head	40	30	20
Drive	Variable	Direct	Direct
Size	4″	3″	3″
Solids to pass	3″	2″	2″

Manufacturer: Aurora Pump Div. and Fairbanks, Morse
Type: Simplex plunger pump

Service	Primary Sludge	Sludge Transfer
Number	1	2
Capacity	80 gpm	80 gpm
Head	50 ft.	50 ft.

Manufacturer: Komline-Sanderson Engineering Corp.

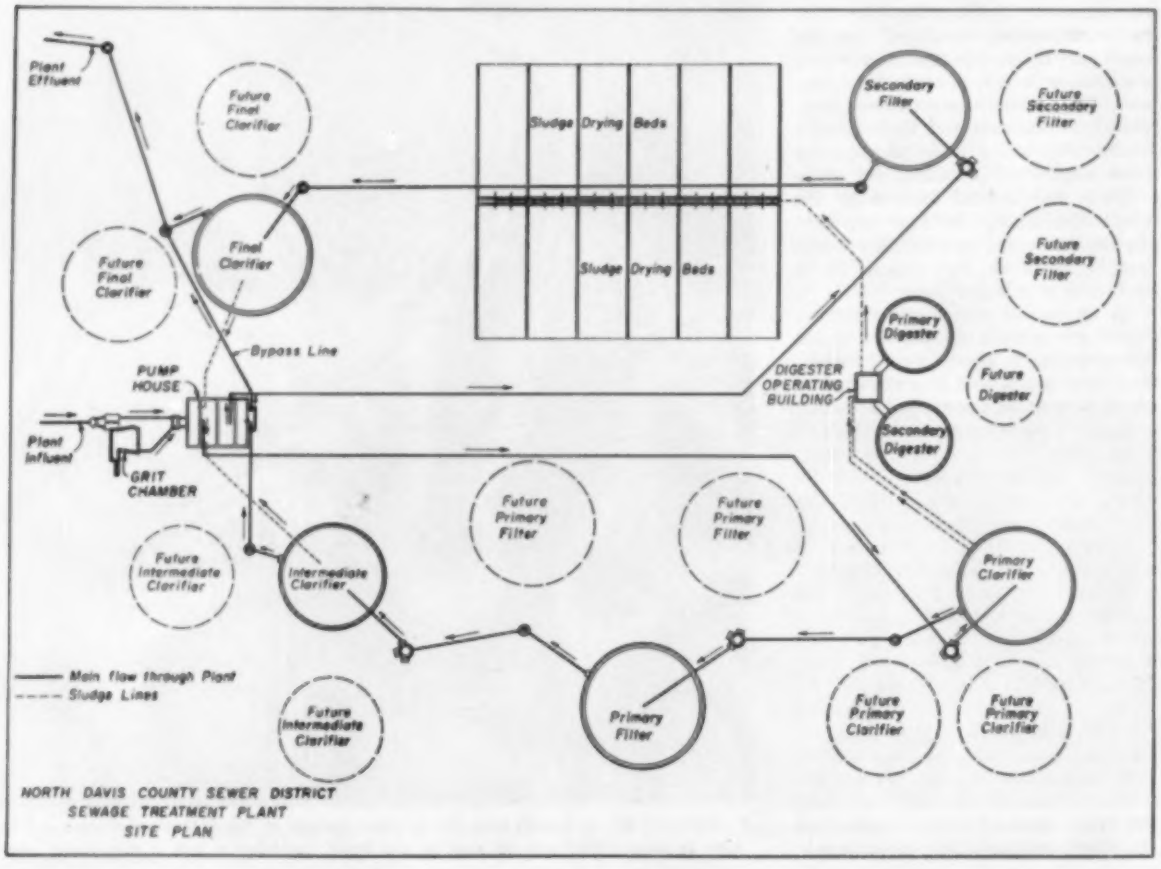
CHLORINATION EQUIPMENT

Type: Solution feed manual chlorinators
Capacity: 2 units, 100 to 2,000 pounds per 24 hrs. each
Manufacturer: Fischer and Porter Company

METERING EQUIPMENT

Location	Raw Sewage	Recirculation
Type	36″ open flow meter	12″ flanged tube meter
Capacity	1,500 to 35,000 gpm	300 to 4,500 gpm

Manufacturer: Ray C. Sparling Company



SAFE WATER SUPPLIES for RURAL NEW MEXICO

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THE PRESENT popular conception of New Mexico has been influenced by the A-bomb development and the resulting changes in the mode of living. Another influence, however, that has been changing the pattern of living in rural New Mexico as much as the famed AEC development, although on a much quieter and smaller scale, is a program carried out by the Department of Public Health to provide safe water supplies in rural unincorporated communities.

There are many of these small communities, especially in the mountain areas, inhabited for the most part by people of a culture and civilization which is older than our own. Noted for their courteous hospitality, their arts and their handicrafts, they are a quiet people who have depended primarily on agriculture and animal husbandry for their livelihood. Mining developments, however, are helping these people to work for wages on a stable, year-around basis.

In many of these communities there are periods during dry years when water is almost non-existent, and even a pot hole in a stream bed must be used as a source of domestic supply. Depressions were dug to hold the water, only too often muddy, unclean and wallowed-in by the cows, horses and dogs of the community; nevertheless it was all that was available. It was used in all homes, for cooking, cleaning, washing, bathing purposes and drinking. The household tasks were always difficult because of the never-ending lack of a plentiful and readily available water supply.

Not realizing the true part played by water supplies in the spread of disease, these people continued to use contaminated water, thus increasing disease. Infant and child mortality was high; but there was no other way, no other water supply —or at least that was the thinking twelve years ago.

Now all that has been changed in many communities and the process is still continuing. In many places the drudgery of hauling water has disappeared. Now families are using washing machines, hot water heaters and sinks. The old familiar scene of a housewife doing her laundry in a creek bed, using a couple of flat stones to pound out the dirt, is fast disappearing. The people are happy and more healthful because now the water comes into the house through a pipe. Hydraulics is unknown to them as a word, but the meaning is clear—plenty of clear, safe water for all household purposes.

The Legislation

How did all of this happen? What brought about such a change? There was no magic formula; just interested people, a good progressive piece of legislation, lots of patience and much hard work. The legislation, known officially as the "Mutual Domestic Water Consumers' Association Act," but more commonly referred to as "The Little Water Bill," was first passed in 1947. An initial appropriation of $40,000 was granted for the purpose of replacing unsafe water supplies in rural

● **TRENCHING to install pipe for a water system at the Village of Penasco. The pipe to be installed can be seen at the right. Installation was a community job.**

unincorporated communities with safe supplies.

In the villages to be affected, the people did not know where to begin, or what steps to take first. Would their lands be taxed, or would they owe money if they took advantage of this tempting gift from the State? These were some of the questions people needed to have answered before embracing this new idea. For a long time the money lay idle with no one asking for a project.

At last the Reverend Leopoldo Martinez, of Los Apodacas, decided that if he could help his community get started, they could have that which they had never known existed for them—safe water. So the first Mutual Domestic Water Consumers' Association was formed, duly incorporated under the laws of the State.

Excitement reached a high pitch in the community when the well rig moved in and drilling started. Little children, old men, young men, ladies with rebozos over their heads and those without, all watched this big machine as the cable rolled up on the drum pulling up the drill, only to drop it with a thud and loosen up more soil, gradually deepening the hole. Never did a driller have a more attentive audience, and never probably was there more discussion about a well, as the drill pounded into the earth.

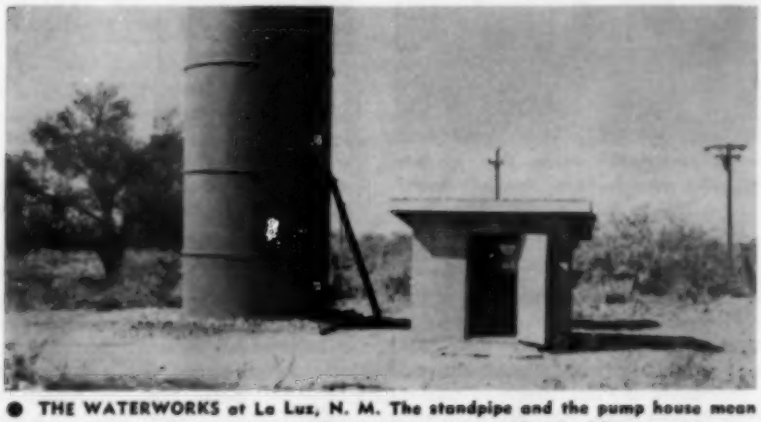
With the well drilled and cased, and an ample supply of water assured, the villagers assumed their part of the work of building a pump house, constructing a foundation for a storage tank and digging a trench for the line to connect the well to the tank. All labor and local materials needed must be furnished by the association.

The State will assist only in developing a basic project: the well and its equipment; a covered, metal storage tank; the line connecting the two, and a supply line to the center or centers of population equipped with community hydrants as needed and as the legal and financial limitations of the law permit. Development of the distribution system and appurtenances such as crosses, tees, fire hydrants, yard taps, extra valves and house connections are encouraged, but at the expense of the association and its members.

The first project, serving twenty-three families, cost $4,600. The association supplied all of the adobes, vigas, sand, gravel and other miscellaneous material which could be obtained locally; and excavated and backfilled the trenches for the supply line. They also mixed and poured concrete, performed the carpenter work needed, and secured the necessary easements for the pipeline and deeds for the land to be occupied by the well and pump house.

At Los Apodacas, the basic supply consists of a six-inch diameter drilled well, seventy feet deep, equipped with a deep-well turbine pump powered with a 5-hp electric motor. The well has an output of about 40 gpm. The water is delivered through 1180 feet of 3-inch and 560 feet of 2-inch pipe to a 5500-gallon covered, galvanized steel ground reservoir located on a hill adjacent to the community. Check and gate valves were installed as needed. The association purchased additional pipe and installed it to provide a distribution system. All of the families now have water in their homes or in their back yards. When we consider that twenty-three families were benefited by that priceless commodity, an ample supply of water, the actual cost is small especially if we compare this cost with the amount an individual home owner would have to pay for his own well development. We can also realize that over the years the purchase of washing machines, sinks, lavatories, hot water heaters, bath tubs and commodes, more pipe, fire hydrants and all of the other items relating to water supply under pressure will continue acting not only to further the interests of public health, but as a business stimulus. A new way of life is being formed in our villages—a way started by the water supply. Thus, a small idea formed in the mind of a former legislator, Senator Filiberto Maestas, has grown and the fruits of his efforts are benefiting and will continue to benefit more and more people. The spirit of cooperation in the local groups is excellent. They have a far better understanding today, not only of their health department, but of their state government.

Basically, the law provides that if more than fifty dwelling units are to be served, not more than $12,000 may be spent on any one community



● **THE WATERWORKS** at La Luz, N. M. The standpipe and the pump house mean a new way of life for small and isolated communities, and a health protection, too.

● **THIS WAS** the community water supply for Marquez before the installation of a safe supply, with water pumped from wells into a standpipe and delivered by pipes.

project. A maximum of $5,000 may be spent where twenty dwelling units or less are to be served, providing that associations may not be formed having less than ten dwelling units.

Local Organization

The associations are incorporated under the laws of the State as Mutual Domestic Water Consumers Associations. The Board of Directors, five in number, are elected by the membership at large. The board chooses among its members a president, vice president, and secretary-treasurer. Each association must make application to the Department of Public Health for a grant-in-aid and agree to contribute all common labor, skilled labor available, and also agree to contribute local materials such as sand, stone, gravel, vigas, adobes, timbers and other materials which can be obtained locally. Their contribution shall equal or exceed one-third of the total estimated cost for a completed project.

● **THE WATERWORKS, old style. Water (contaminated water, that is), was hauled from the river or mudhole in barrels. The normal charge was 50¢/barrel.**

Participation in the actual construction of the project helps to emphasize the pride of ownership and the feeling of civic responsibility. Such participation adds to the difficulties of organization, planning and execution of the project as each member has his own ideas. These people have never been regimented, nor have they ever understood the need for acting in concert, yielding to the principle of deferment of individual opinion in the interest of a common cause, by vote of the majority. The projects are therefore difficult to construct in a systematic, organized manner.

Using the $40,000 appropriated in 1947, the Department was successful in undertaking seven projects, although only four had been contemplated. This was brought about by utilizing to the utmost local materials and supplies, old doors and windows, logs and bricks from abandoned buildings. All sand, gravel, trucking, form lumber, fencing and anything else available locally was used in construction. Difficulties were encountered in securing some materials due to the defense effort. Pipe shortages, sheet metal shortages, delays in securing pumps all added to delays and difficulties.

Some associations posed special problems. One insisted that a so-called spring be used as a source of water. This spring actually was arroyo seepage and of course subject to flooding after each rainfall. The Department of Health insisted on using a drilled well which would afford a safe source, though admittedly the water would be harder. The matter was serious to these people, as they doubted that they could cook their "frijoles" (beans) in well water. After two years of conferences the well was drilled; beans are still being used as a major part of their diet, and everyone is happy.

In some areas our geologic data were insufficient to forecast ground structure. Cave-ins due to quicksand or loose soil occurred. Quick decisions and plan changes had to be made to re-orient planning with the unexpected. Gravel packing of wells to provide an aquifer and to prevent sand intrusion was resorted to frequently to save a well or to develop an additional quantity.

In the first two years of operation of the program we learned a great deal about the formation of associations, the approach to the people and the method of handling contracts. Patience and understanding are essential in dealing with the community. Because of local rivalries, and the eternal conflict between the old and the new way of thinking, they become easily discouraged. Ditch water was free—this new method requires effort and the water must be paid for each month. Monthly assessments are of course necessary to maintain and operate the supply.

In 1949 the law was changed to permit the Department of Public Health to engage consulting engineers, W. F. Turney and Associates of Santa Fe, to handle the field surveying, plans and specifications. This plan obviated the necessity for the department to engage a surveying crew and purchase expensive instruments and equipment, all of which would not be in use on a year-around basis. An appropriation of $150,000 was approved by the legislature that the work might be accelerated.

Program Expansion

The seven projects already completed served to demonstrate the value of the program and to stimulate interest among surrounding communities. The idea began to snowball until the Department had more applications than could be financed.

Another $150,000 was appropriated in 1951, 1953, 1955, 1957, and 1959. Success was scored in more and more of the larger communities where the public health need was greatest. The eventual easing of the materials shortage permitted more rapid promotion and development.

We are still explaining that frijoles can be cooked in well water despite all claims and arguments to the contrary. Another problem was raised which now is a humorous anecdote. For one of the association projects plans and specifications called for drilling a well on a site selected by a geologist, and the tank was to be located on a hill, to supply adequate pressure for the entire community. But the town was divided politically with little show of real cooperation. Both groups were afraid the other side would control the new water system and the prestige of ownership. Pressure was exerted on their local leader, who with the wisdom of Solomon decreed that the well would be drilled in one end of town and the storage tank would be placed at the other end of town; thus dividing the system. The fact that the wellsite he had selected would probably result in a dry hole, and the more obvious fact that the storage tank would not serve any useful function in his selected location, did not deter this parceling out

(*Continued on page* 179)

PRINCIPLES OF SOIL ENGINEERING

ROBERT F. BAKER, Professor of Civil Engineering, The Ohio State University

THERE IS NO MORE universal and ever present construction material than soil. It is so frequently a part of a civil engineer's structure that one could expect a well-developed scientific approach, familiar to all. However, the complexities of soil behavior prevented rational analysis until recent times. Even under the rigorous approach of soil mechanics, empiricism ultimately rules, and much research must still be accomplished before soil behavior can be predicted with the same assurance as can be done for steel or concrete.

The study of a subject, particularly of the basic principles, leads to a feeling of confidence in dealing with that subject even though the detailed procedures are not comprehended. Knowledge of the over-all technique permits straight-forward consideration. For example, many civil engineers called upon to approve structural plans could not analyze the complex stresses in an indeterminant structure such as a continuous slab or a rigid frame overpass. However, their fundamental understanding of structural analysis provides the necessary confidence to discuss and even revise the plans. On the other hand, foundation requirements for the substructure will cause considerable concern to these same engineers unless the clouded, mysterious subject of soil behavior has been explained—not in detail, but in terms of basic principles.

As a result of the lack of knowledge of the fundamentals of soil behavior, engineers tend to (1) ignore the subject or to (2) over-rate the complexities. In the first case, serious maintenance problems (under-design) or waste of money (over-design) will tend to prevail, depending upon the problem and upon the experience of the engineer. Over-rating the complexities is undoubtedly more common than ignoring soil problems, and the result is an unnecessarily disquieting experience for those engineers who do not have ready access to a soils specialist.

It has been the firm conviction of the writer for several years that an understanding of the principles of soil behavior would permit proper cognizance of the influence of soils on the structure. As a result, for those cases when soils have a nominal effect, no special precautions are needed. Equally important, where the soils control the performance, and where hazard or economics require stability or low maintenance, the need for a specialist will be recognized.

The following discussion of the engineering characteristics of soils will be over-simplified in order that the principles will be more clearly evident. Detailed procedures and concepts will not be included. However, an effort will be made to impart an understanding of why certain ideas are important and *how* soil behavior ultimately affects a structure.

In the following article, the subject of soil engineering will be discussed under three major headings: Part I—Physical Properties, Part II—Design Considerations, and Part III—Construction Applications. All of the important fundamentals are included in Part I, with the subsequent two sections expanding on these basic properties by demonstrating their application.

Soil mechanics are based upon the elastic theory—just as are structures. The problem is to determine the stresses imposed and the ability of the soil to take those stresses. Essentially, then soil problems can ultimately be reduced to those concerned with (1) stability or with (2) settlement. No other types of problems are involved except the very special considerations of permeability (through an earth dam or into a well system). Therefore, in considering why a soils study will help, one must ask whether sudden failure of the soil in shear, or extensive settlement under load, or both can occur.

While the possible influences of soil behavior on a structure are not difficult to comprehend, estimating the actual, quantitative effect can be extremely complex. For smaller structures, some knowledge of the methods along with experience in an area may permit satisfactory treatment. On larger scale projects, however, probabilities of shear failures or excessive settlement will dictate more expert analyses.

Part I—SOIL PROPERTIES

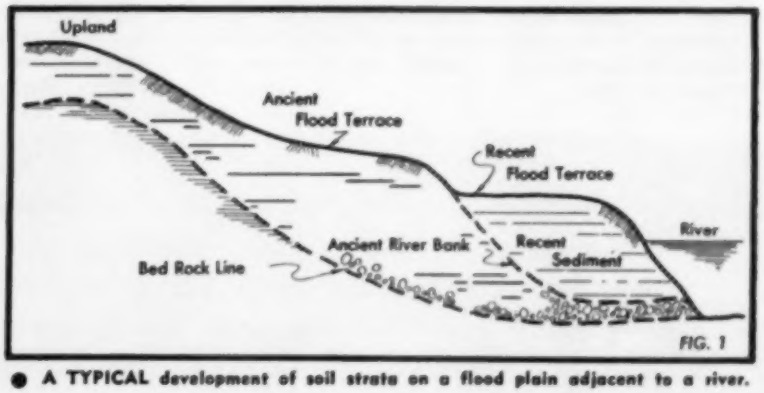
ONE OF THE MOST practical complications that occurs to an engineer is the fact that soils appear to vary so much from spot to spot and from season to season. These changes have been referred to as *variation* (change in soil type from one location to another) and *variability* (change of the same soil due principally to compression or climate). In reality, this is the same question that is encountered in dealing with any other construction material except that the engineer cannot with frequency "order" the characteristics of the soil he will use as he can for concrete or steel. Thus, in dealing with soils we need to know what we have, how much is there, and how it will react to stress throughout the life of the structure, rather than how to be sure that what is ordered is placed in the structure.

The recent studies of soils for engineering purposes have generally reduced the data to soil profiles or to "areas." In the former, the surface of a soil layer is plotted in the same manner as the surface of the ground is plotted in any centerline profile. Soil areas are plotted similarly to any plan view in that areas for which soils do not change significantly with depth are enclosed by a continuous line. Soil areas are easier to develop and to apply, particularly on a highway or city street problem, but many agencies still prefer to use soil profiles.

In comprehending the "what" and the "how much" present in the soil question, a knowledge of geology permits a better understanding upon which to base a profile or an area. If one realizes that natural forces can produce areal variations, a logical explanation of soil occurrence is more easily determined. For example, adjacent to major streams, a "flood terrace" or flat area is normally present. This terrace is higher than the stream but lower than the "upland" or areas further from the stream (See Figure 1). These terraces have developed in the earlier stages of the river history. The soil layers can be predicted and the past history determined by relatively few drill holes on the basis that larger particles (gravel) will settle out of rapidly moving water, whereas smaller particles stay in suspension until the velocity of the stream is reduced. This condition and similar logic considerations can materially assist in obtaining and interpreting soil data.

The variability or change of soil with climate (or load) is no different, basically, than the same problem with concrete or steel. The important effect on the structure, however, is not the same. Thus, while expansion, curling, and warping produce stresses that are important with portland cement concrete slabs, change of strength is the major consideration with soils. In this respect, soils are more comparable to bituminous concrete. As should be obvious, then, with soil variation, the principal question is concerned with predicting the weakest condition in which the soil will exist and the stresses that will exist at that same time. The most troublesome problems of this type are concerned with subgrade behavior under pavements. For a rational solution efforts should be made to test the soil under the most expanded, saturated conditions that the soil is likely to assume after the pavement is placed. In principle, this is not unlike predicting the strength of a steel member within the life of a structure that is exposed to corrosive effect, even though techniques used are quite different. For accuracy it should be noted here, however, that many empirical pavement design procedures have been based upon some other soil condition.

In order to understand better the physical occurrence and behavior of soils, the physical properties and nomenclature common to soils technology must be understood. Frequently, lack of understanding can be traced to the fact that precise terminology is being utilized by the practical soils engineer whereas



● A TYPICAL development of soil strata on a flood plain adjacent to a river.

a general, "Webster" definition is being interpreted. For example, the word "consolidated" has a precise meaning that goes beyond the layman dictionary. In the first part of this article that follows, the more important definitions and physical properties will be discussed. The discussion is divided into the following major sections; (1) Soil Physics, (2) Classification, (3) Strength Properties, and (4) Field Tests.

SOIL PHYSICS

Each engineering material has its own special definitions and conventional approaches. To some extent, the differences are neither necessary nor warranted, but have resulted from empirical development along separate, non-integrated lines. In other cases, certain properties are more critical with one material than another so that they are ignored in one case and accentuated in another. In soils, three properties of importance are: (1) volume-weight relations, (2) grain size, and (3) soil moisture.

Volume-Weight Relations

In dealing with soils, the two most frequently encountered relationships are unit weight (or density) of a compacted or in-place soil, and moisture content. These two factors are defined as follows:

$$\delta = \frac{\text{Total Weight (W)}}{\text{Total Volume (V)}} \quad \ldots\ldots(1)$$

$$W = \frac{\text{Wt. of Water } (W_w) \times 100}{\text{Wt. of Soil } (W_s)} \ldots\ldots(2)$$

where:

δ = Unit Weight (Density)
W = Moisture Content (%)

Soils in-place range in density from 90 to 140 lbs. per cu.ft. and normally have a moisture content of at least 5% and may have values over 100%. Note that over 100% water merely means that W_w is greater than W_s. To obtain a better understanding of these and other relations, Figure 2 will be helpful. In Figure 2(a), the normal structure of a soil in-place is pictured. Various-sized grains of soil along with water and air make up the total soil volume. The diagrammatic sketch of Figure 2(b), however, is easier to work with, and is conventionally used in soil engineering. Here, the soil particles are considered to be completely concentrated or isolated into the volume V_s, as is the water into V_w. Of special note is the fact that the volume of "voids" (V_v) is defined as all of the volume that is not soil; i.e. void volume equals the volume of the water plus the volume of the air. There is a special reason for this convention as to voids—a firm basis is desired for the comparison of total water that could be in the system, with the weight and volume of soil particles.

Frequently the weight of the soil particles in-place in the ground, exclusive of the weight of soil, is desired and referred to as the unit weight (dry) or the dry density. The term can refer to any soil condition even though there is water present, and is defined as follows:

$$\text{Unit weight (dry) or Dry density} = \frac{\text{Weight of Soil } (W_s)}{\text{Total Volume (V)}} \ldots\ldots(3)$$

The difference from equation (1) is that the weight included is only the W_s of Figure 2(b) rather than W.

The immediate question may be why not use the volume of the soil, V_s, in the relation shown in equation (3). The reason lies in the fact that for the unit weight (dry) the "outside" volume required by the arrangement of the soil particles is desired. The weight-volume ratio of the soil particles is the basis of the conventional specific gravity (G):

$$G = W_s/V_s\delta_w \quad \ldots\ldots(4)$$

where:

δ_w = Unit weight of water (62.4 lbs. per cu. ft. or 1.0 gm. per c.c.) The value, G, represents the average specific gravity of the individual soil particles and ranges in nature from 2.4 (organic clays) to 2.9 (inorganic clays). The specific gravity of silica sands ranges between 2.62 and 2.67.

Figure 2(b) is a convenient tool to compute weight and volume relations. For example, knowing the weight of soil particles, W_s, and their specific gravity, G, the volume, V_s, can be computed using equation (4). Since the volume of water is its total weight divided by its unit weight, V_w can also be computed by measuring the loss in weight after oven drying and dividing the loss by 62.4 (English system) or is equal to the volume in the metric system. In soils engineering, the slight variations in temperature, as well as the other intangibles, permits the assumption that δ_w = 62.4 lbs. per cu. ft. For example, if a soil is weighed (12.55 lbs.) before oven drying and again after oven drying (10.5 lbs.), and the soil particles have a specific gravity of 2.70, then:

$V_s = 10.50/2.70 \times 62.4 = .062$ cu.ft.
$W = 12.55 - 10.50/10.50 \times 100$
$= 19\%$
$V_w = 12.55 - 10.50/62.4$
$= .033$ cu.ft.

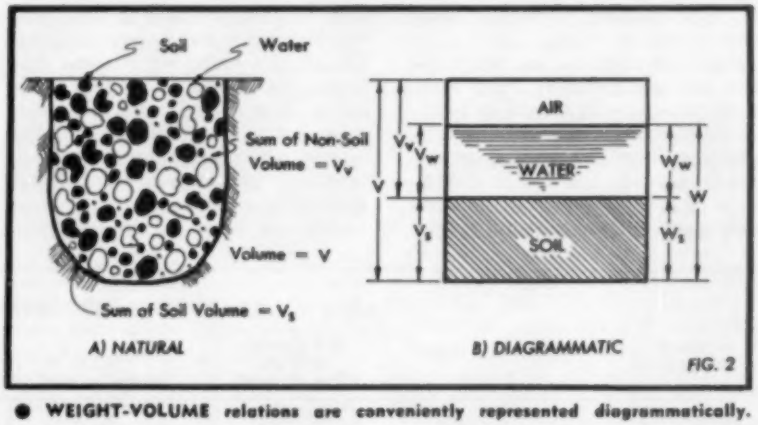


FIG. 2

● **WEIGHT-VOLUME** *relations are conveniently represented diagrammatically.*

If the total volume, V, is measured, and the weight (W_s) and the specific gravity of the soil particles (G) are known, the soil volume, V_s, and the volume of voids, V_v, can be computed. Knowing the weight of water, W_w, permits the determination of V_w and all of the necessary parts of Figure 2(b). For example, if the volume of the soil-water-air system in the preceding example is 0.108 cu. ft. then:

$V_v = V - V_s = 0.108 - 0.062 = .046$ cu. ft.

On occasion, the porosity (n) and void ratio (e) are utilized to com-

pare soil conditions or variations. These factors are defined as:

$$n(\%) = V_v \times 100/V \ldots\ldots (5)$$

$$e = V_v/V_s \ldots\ldots\ldots (6)$$

It will be noted that porosity is expressed as a percent, whereas e is a ratio. These two terms are normally utilized in highly specialized problems, so are rarely used by other than the specialist. To compute, using the data from the preceding example:

$$n = .046/.108 \times 100 = 42.6\%$$

$$e = .046/.062 = 0.742$$

Normally, a given soil loses strength as the moisture content increases; i.e. as the volume of water, V_w, becomes equal to the volume of voids, V_v. To express this relation the degree of saturation, S, is utilized and defined as follows:

$$S\ (\%) = V_w \times 100/V_v \ldots\ldots (7)$$

In the preceding example, the degree of saturation is 0.033 divided by 0.046 or 0.74, times 100 equals 74%. It will be noted that the degree of saturation cannot exceed 100%, whereas the moisture content can increase indefinitely. Therefore, references such as "super-saturated" can mean nothing more than complete saturation.

Many soil problems are concerned with near-saturated or 100% saturated conditions. It should be pointed out that 100% saturation is difficult to achieve. Frequently, entrapped air persists, and a small quantity of the voids may not be filled with water. In addition, the specific gravity, G, is difficult to measure, and as a result, values for S from 95% to 105% are normally assumed to represent complete saturation. Obviously, values greater than 100% are in error, but the source of the error is not always determinable.

Grain Size

The size of individual particles in a soil mass is of considerable interest in engineering problems. The most frequent application is in the identification and the description of soil types; i.e. establishing the similarity or variability of soils. There are some empirical guides to performance based upon soil particle size, such as some building code references to bearing capacity and some pavement design criteria. However, it is important to remember, that an accurate estimate of soil behavior cannot be based upon particle size alone. For minor problems, strength inferences (with an adequate safety factor) can be made from grain size, but this is true only because the cost of detailed soil analyses are more expensive than an obvious over-design.

Grain size is conventionally expressed for engineering problems in terms of (a) millimeters (mm) for the smallest sizes; (b) sieve numbers for intermediate grains; and (c) inches for the largest particles. The sizes are divided into the following five groups, ranging from largest to smallest: *gravel, sand, silt, clay,* and *colloids*. Because of the several scientific areas that have been interested in soils (agriculture, geology, engineering, etc.), separate approaches have led to arbitrary, non-essential divisions between the several grain-size groups. Several of these are included in Table 1. Which of the several is used makes little real difference, but for purposes of comparison, most data are divided into the engineering basis for highway, airport, and foundation problems. However, if other than engineering sources of information are used, one should ascertain the break-points in the size relations.

Natural soils are always composed of particles with varying grain size, and laboratory tests are used to determine the percent of the various sizes that are present. An interesting perspective is that grain sizes are relative in the sense that all particles constitute pieces of rock. To be completely accurate, some are pure, or relatively pure minerals, rather than a group of minerals. No basic difference in performance occurs, however, until the "rock" size becomes so fine that the individual particles can no longer be seen. At this point, surface area considerations, along with water, produce significant differences in behavior. The larger particles are termed *granular*, and the smaller, *cohesive*. More detail will be given in subsequent sections relative to the differences between granular and cohesive soils. It is important to know that from the viewpoint of engineering works, the distinction between granular and cohesive is far more important than the artificial, identification break-down.

Soil Moisture

All of the major soil problems revolve around the impracticality of

TABLE 1—GRAIN SIZE GROUPINGS

Group Designation	U.S. Bureau of Soils (Size in mm.)	M.I.T. (Size in mm.)	ASTM* and AASHO (Size in mm.)	Bureau of Public Roads (Size in mm.)
Clay	< .005	< .002	< .005	< .005
Coarse		.002 to .0006		
Medium		.0006 to .0002		
Fine (Colloidal)		< .0002		
Colloid			< .001	< .001
Silt	.05 to .005	.06 to .002	.05 to .005	.05 to 0.005
Coarse		.06 to .02		
Medium		.02 to .006		
Fine		.006 to .002		
Sand	1.0 to .05	2.0 to .06	2.0 to 0.5	2.0 to 0.42
Very Fine Sand	.1 to .05			
Fine	.25 to 0.1	.2 to .06	.2 to .05	0.42 to .05
Sand	.5 to 0.25			
Medium		.6 to .2	.6 to .2	
Coarse	1.0 to 0.5	2.0 to .6	2.0 to 0.6	2.0 to 0.4
Fine Gravel	2.0** to 1.0			

*ASTM—D 422-39; AASHO—T88-49 ** No. 10 Sieve

maintaining a constant moisture condition in the soil. The fact that moisture is combined with solid material does confuse soil behavior somewhat, but insignificantly as compared to the *changes* that take place. The difficulties stem from the fact that both volume and strength can change as a result of moisture movement. Therefore, the role of water in soil behavior must be understood if the performance in engineering works is to be anticipated.

If a natural soil is allowed to air-dry under relatively low humidity conditions, a certain amount of moisture still remains. This water content is termed "hygroscopic." While soils are normally considered "dry" if placed in an oven at 220° F. for 24 hours, water will continue to be driven off at even higher temperatures. In fact, losses will still occur at temperatures of 1500° to 2000°. The moisture affected by these higher values is intimately associated with the very structure of the minerals that form the particles. However, in civil engineering problems, the effect of temperatures above 220° F are of primary interest only to the researcher and to the specialist. Suffice to say, soils can be considered to be "dry" (and thus contain nothing but soil particles) if temperatures of 220° are used for determining the relations of Figure 2(b).

Everyone knows from observation that a clay soil changing from a relatively wet state to a dry condition changes from a "plastic" material that can be molded into a firm, brittle mass. The water that tends to "lubricate" the particles so that the soil can be molded is essentially the "free water" or water in excess of that which is easily removed. Some of the water that still remains after oven drying is termed "cohesive" and imparts the brittleness to a clay-type material. The water is frequently represented as surrounding the soil particle as shown in Figure 3. The so-called cohesive moisture requires "cooperation" from the grain size to be effective in that surface area must be large as compared to the weight of the particle. Thus, only the fine-grained soils display cohesion. While the foregoing is an over-simplification, it is accurate as a representation of the effect of soil moisture.

As suggested previously, if soil moisture would remain constant, engineering problems concerned with soil behavior would have been solved countless years ago. However, water moves as vapor and as a liquid under various forms of pressure or tension. The most common phenomenon is the dampness which collects under a board that is placed in an extremely dry atmosphere. The same occurrence tends to develop under surfaced pavements (other than a low-type, open-surface pavement). Water also moves as a liquid under direct pressure, and the phenomenon is termed *seepage*. The ease with which the water moves is termed the *permeability*, i.e., the higher the permeability, the larger is the quantity of water that can flow through the soil. Generally, the coarser the particles the greater is the permeability, since the void space is greater. The exceptions are where coarse particles are involved with the right quantity of smaller particles to fill the voids.

● **FIG. 4. A benched rock slope on US Route near Huntington, West Virginia.**

At some surface beneath the ground is the *water table*, which can be thought of as the upper surface of a saturated soil or rock mass. Much could be said as to the importance of the water table relative to engineering, but for the moment, the surface can be considered as if it were existing for any body of water, such as a lake. When water evaporates from this surface and moves upwards, the vapor movement described earlier occurs. In addition, *capillary* action can develop. *Capillarity* is the phenomenon that is seen in a conventional soda straw, wherein a liquid will rise ⅛ to ¼ in. above the level of the surrounding liquid. It is actually a tensile force, related to surface tension of liquids and is most effective where the "tube" (or series of voids) is of a very small dimension. Thus, water can rise through the small "tubes" in the soil for great heights. Due to the small size of the individual void spaces, the fine-grained soils produce the greatest rise if sufficient time is permitted for full capillary action to take place.

● **DIAGRAMMATIC representation of moisture surrounding a mass of soil.**

The height to which water will rise by capillarity is greatest in a clay, but the *speed* with which it progresses is greater in a coarser material like silt. From a structural viewpoint, silt will generally produce the most serious problem if frost exists in the area. This occurrence results from the fact that the capillary water is changed into ice (frost action), expansion develops, and more water can flow upwards to be turned into ice. In temperate climates, the duration of the cold spells is so short that clays rarely produce as much of a problem as the more permeable silts. Sands and gravels are no problem unless there are sufficient fines to reduce the size of the voids.

One common misconception with the permeability phenomenon is related to granular courses that underlie pavements or structural slabs. *The mere fact that a coarse material is present does not mean that a per-*

meable layer exists. Actually, relatively impermeable cores for earth dams have been built using gravel-size material. If finer-grained material is present in the right size and quantity so as to reduce the void space, a low permeability can develop. Thus, a dense-graded base course may be, and probably is relatively impermeable.

There is also a tendency to over-evaluate the ability of a drain to lower the water table in an area. Particularly in clay-sized soils, the lower permeability means that a much smaller area of the water table is affected by the drain, as well as the fact that a relatively small quantity of water will flow into the pipe. The deeper below the water table the pipe is placed, the greater the (a) area of the water table that is affected and (b) flow into the pipe, and (c) the cost.

Another troublesome feature of water movement results from loads that are applied to a saturated soil. The immediate influence of the load is to force the grains closer together, thus decreasing the volume of the voids, V_v. However, until the water can flow out of the saturated mass and relieve the pressures thus developed, the soil particles remain in "suspension" and a critical condition as to strength exists. Furthermore, if the soil is a clay, and the permeability is low, the water will continue to be forced out for years. The explanation for this long-time removal of water is termed the "consolidation" theory of soil mechanics and leads to estimates of the rate of settlement, particularly those that continue for many years..

Most of the troublesome features of the water movement or water presence in soils will be discussed again in subsequent sections.

SOIL CLASSIFICATION

Perhaps no other phase of soil engineering has been more emphasized and misused than has been the classification systems and the tests that are used for classification. The faults probably stem from a lack of appreciation that classification is merely what the word suggests, a grouping of soils that have comparable engineering characteristics insofar as the tests used for the purpose can reflect. The problems tend to arise when classification tests or systems are used to generalize as to strength properties.

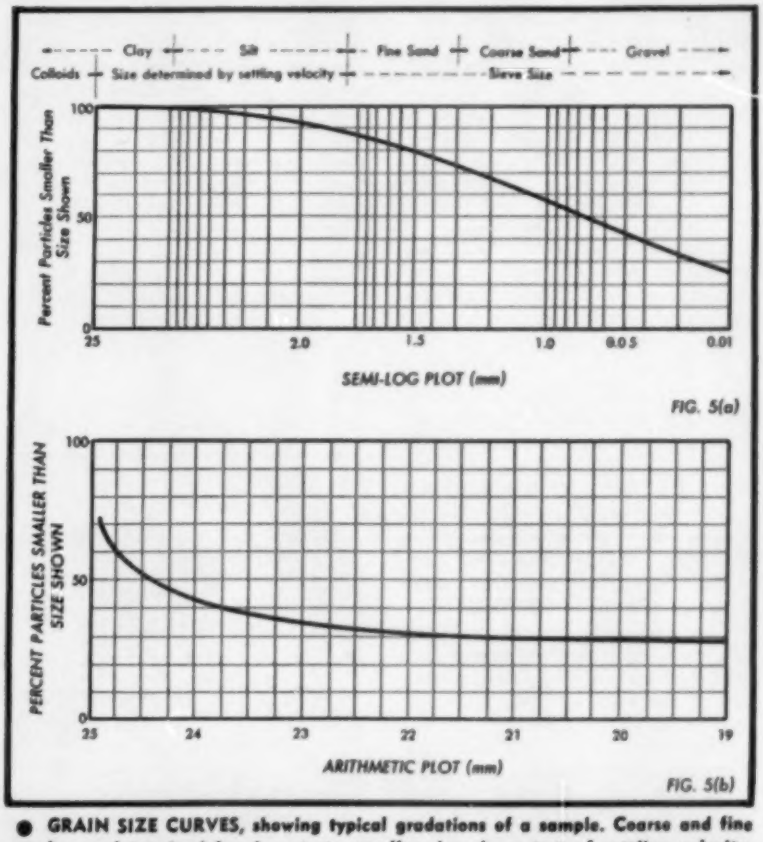
One should not infer that the writer does not believe in classification, nor in the ability to achieve a certain level of success by carefully developed, empirical techniques based upon classification. The blunt statement was to emphasize the fundamental purpose of classification; i.e. to group soils in such a manner as to facilitate the discussing and analytical testing of the material. Furthermore, empirical procedures can never work 100% of the time even for the conditions actually studied. Thus, their application to areas and to conditions dissimilar from the original study has no predictable validity without considerable evaluation. Certain generalities can be made with regard to strength as influenced by factors related to classification. Where the problem is a small one and over-design is less costly than a detailed analysis it will be possible to use classification in a dual role. Application of these generalities to complex problems, however, will lead to a finite number of serious difficulties or over-expenditure.

The preceding caution as to the use of classification and the tests so associated should not detract from the role that is played by the grouping of soils. Classification of some type is accomplished by all practicing soil engineers, and is a prerequisite to a systematic evaluation of the problem. In the following, classification will be discussed under the headings of (1) laboratory tests, (2) field identification and (3) classification systems.

Laboratory Tests

There have been numerous laboratory tests used in past years for classification purposes. However, at the present time the only procedures used extensively are the mechanical analysis (grain size determination) and the consistency tests (Atterberg Limits). The specific gravity is required for part of the mechanical analysis, and is also of value in determining degree of saturation and other physical relationships.

The details of the test procedure are not included in the following discussion. While some variations



● **GRAIN SIZE CURVES, showing typical gradations of a sample. Coarse and fine sands are determined by sieve tests, smaller sizes by a test of settling velocity.**

exist in the manner in which the tests are conducted, ASTM and AASHO have adopted and published standards which are readily available. For the purposes of the article, the details of test procedure are not essential to a comprehension of the "why" and the "how used" aspects of the tests.

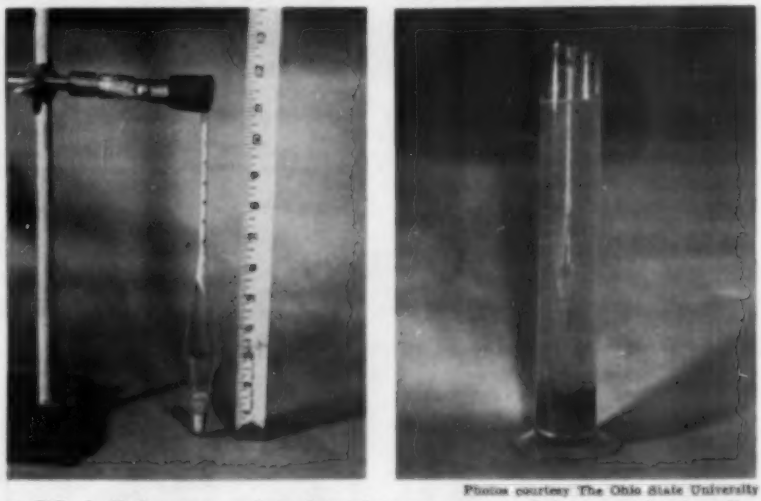
Mechanical Analysis

The determination of grain size consists of two parts; one, a sieve analysis, and two, an hydrometer analysis. In the former the purposes and test data are identical to those for sieve analyses of aggregates for base courses, portland cement concrete, and bituminous concrete. Different sizes of sieves are used, but no fundamental reason exists for using a specific sieve size for any of the several materials. For soils, due to the larger quantity of fines, smaller sieve openings are normally required.

Due to the impracticability of maintaining the very small openings at their prescribed distance and position sieve analyses for material finer than the No. 100 sieve (see Fig. 5a) are subject to suspicion. Furthermore, clay and silt sizes are likely to adhere to the coarser particles so that "wash" procedures are frequently utilized where there is a significant quantity of both coarse and fine material present. Simply speaking, the test consists of placing a measured (by weight) quantity of the soil in the top of a nest of sieves, and the part that passes the upper (larger) sieve and is retained on a given sieve is weighed. The residual is caught at the bottom in a pan and is normally designated as "pan," and represents the weight that passes the finest sieve. The weights retained on each sieve are transformed into percents of the original weights. If the sample selected is truly typical of the soil, then the grain size so determined is "typical" of the whole and can be so represented. Obviously, some variations will exist in two tests on the same soil, and differences of the order of 5 - 10% for a given size are rarely of practical significance. Naturally where a specification is involved, even one percent can be critical. In such cases, a number of samples must be conducted in order to establish the nominal value.

Sieve analyses are normally plotted on a semi-log basis in terms of "Percent Finer" for a specific size. The percent value is plotted arithmetically as shown in Figure 5a, whereas the grain size is plotted on a logarithmic basis. The only reason for the use of a logarithmic plot is to provide a good description of the finer portion without having to use a very large piece of paper. For example, in Figure 5b, the use of an arithmetic base for the grain size produces no value from a pictorial sense for the small-sized particles.

As has been mentioned, sieves are of value only in determining the grain size of the particles larger than the No. 100 or No. 200 size. To obtain the percent of smaller sizes present, an hydrometer analysis is used. Two basic physics principles are involved with this test: one, that a larger particle settles at a more rapid rate through a liquid than does a smaller one (Stoke's Law); and two, that the specific gravity of a liquid can be measured by the buoyant effect on a specified volume and weight. The second principle is an application of Archimedes Principle and is the same as that utilized for determining the amount of anti-freeze in automobile radiators.



Photos courtesy The Ohio State University

● **FIG. 6. Hydrometer analysis determines percentages of fine particles in soil.**

In Figure 6 there is a photograph of the equipment for the hydrometer test. One of the practical problems encountered in the test is that of "breaking up" the cluster of soil particles so that individual grains settle through the water. Overnight soaking, chemicals and a stirrer (malted milk shaker) are utilized for this purpose. The dispersed soil and water are poured into the glass cylinder and the test data consist of the original weight and specific gravity of the soil, the total volume of soil and water (normally 1000 cc), and the specific gravity of the soil and water system at various time intervals. For these last data, the hydrometer is used.

For the test it must be assumed that a complete, intimate mixture of the soil particles is present at the time the specific gravity measurements are begun. In reality, the hydrometer measures the specific gravity at a level approximately 4 to 6 inches below the surface of the liquid. At the instant the test starts, the specific gravity of the system is that of the water with the total soil dispersed through it. At each subsequent time interval, two facts are determinable; one, the maximum sized particle that can still be in suspension at the level the specific gravity is measured; and two, the reduction in specific gravity since time $t = 0$. As to the first fact, computations are made of the size of the particle that would settle (in the time period since the test began) from the surface of the liquid to the level at which the specific gravity is measured. This value, then, constitutes the largest particle that could be still in suspension at that level; i.e., all larger particles would have settled further.

At the level that the specific gravity is being measured, it can be assumed at any time that the only thing that has changed throughout the test is that larger particles have been removed; i.e., the same relative percentages of the finer material remain, since as many finer particles have settled out as have come down from above. Thus, the percentage of the original soil weight, finer than the computed grain size for a given instant, is the

ratio between the changes produced in the specific gravity of the soil-water mixture.

For approximations it can be assumed that the largest silt-sized material will settle out within one hour, leaving nothing but silt and clay-sized particles. In four hours, nothing but clay sizes remain. Occasionally, these estimates are utilized for rough field values. However, failure to separate soil particles will lead to evaluating "clusters" of clay particles as silt and fine sand sizes.

The complete data (sieve and hydrometer) are plotted on a single curve as shown in Figure 5(a). The term "clay" causes some confusion since, to mineralogists, clay implies certain structure and behavior. It is becoming more prevalent to specify .002 mm as the largest clay particle instead of 0.005 mm. The particles finer than .001 mm are designated as "colloids."

To utilize the mechanical analysis for classification, the percentages of sand, silt and clay are normally used. Some systems are based upon the percentage finer (or coarser) than a specific size or sieve number. Since soils consist of a combination of particle sizes, the designations of clay, sandy-clay, silty-sand, etc., are used. Generally the predominant percentage is the basis; i.e., a silty-sand may have 40 to 70% sand, 10 to 50% silt, and 0 to 10% clay. Some classification systems rely solely on the grain size data.

One implication that can be made from the grain size curve is that it is "long graded" or "short graded." For the former, there is a wide range between significant percentages of the largest and smallest particle size. On the other hand, short-graded material will be practically all one-sized; i.e., loess is 80 to 100% silt-size. The short-graded will be more permeable and have less inherent stability unless confined. Generally, short graded materials are difficult to handle from a compaction viewpoint. Further, such material may not support, without rutting, the weight of the construction equipment.

Consistency Tests for Fine Grained Soils

A good perspective as to the meaning of the consistency tests comes from the following illustration of soil behavior under various moisture contents. In Figure 7, one can assume that one pound of soil is mixed with enough water that essentially a liquid (such as river water) exists. The total volume may be several cubic feet. If the water is permitted to evaporate, a heavy viscous mud eventually will develop. At some point in this evaporation process, the soil-water mix will no longer flow readily as a liquid. The moisture content at this point is termed the *Liquid Limit* (LL).

If the evaporation continues, the soil is in a condition that permits molding (such as modeling clay). During this stage, the soil-water mix is considered to be in the plastic phase. As drying continues, the soil reaches a moisture content at which it can no longer be readily molded. This moisture content is called the *Plastic Limit* (PL). At moisture contents below the plastic limit, a state of semi-elastic behavior is assumed. During the entire drying cycle, from the liquid to the semi-elastic stage, volume change has been equal to the loss of water. Rather abruptly, this relation no longer holds and the material is assumed to be at the moisture content termed the *Shrinkage Limit* (SL). Below this water content, conditions of elastic solids are assumed. It will be noted that 100% saturation exists from the highest moisture contents to that for the shrinkage limit.

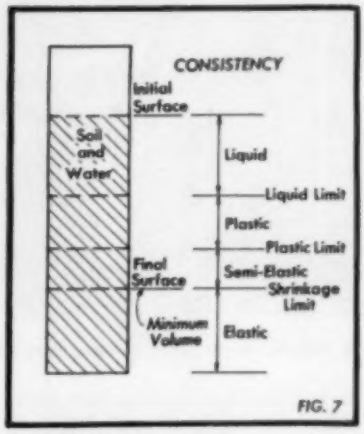


FIG. 7

● **AS WATER content is decreased, consistency of a soil sample changes.**

One other value of interest is quite frequently used in classification. This is the Plasticity Index (P. I.), and it is defined as the liquid limit minus the plastic limit. Thus, the P.I. is a moisture content although the percent sign is never used. The physical meaning of the P.I. is that it is the range of moisture content over which the material is in the plastic stage; i.e., the lower the P.I. the sooner the material passes through the plastic phase (or the less likely that the material will be in a plastic stage.)

Although many specifications refer to the P.I. it is obvious that the plastic limit value may actually be more critical, as could the liquid limit on occasion. However, the tendency for the soil to remain plastic over a wide range (high P.I.) is an indication of the presence of an active clay. Thus, a low P.I. value is desirable in a base course under a pavement. Actually a relation exists between the P.I. and the LL; i.e., the higher the P.I. the higher the liquid limit.

It should be noted that the foregoing relation applies only to fine-grained soils. Actually very fine sand and silts display only a slight tendency to develop liquid or plastic limits. Coarser sands merely tumble around or settle out of excess water.

While the consistency relations suggest certain behavior characteristics, from a descriptive sense, this is as it should be. However, more positive means exist for determining the engineering characteristics of soils.

From a practical viewpoint, the transition from a liquid to a plastic stage is indefinable. However, arbitrary empirical procedures have been established. The equipment is pictured in Figure 8(a). For the liquid limit, a soil-water mix at a moisture content above the liquid limit is placed in a brass cup, a standard width groove is cut, and the cup is raised and allowed to fall freely onto a solid base. When the moisture content is such that the groove just closes after 25 falls, the soil is considered to be at the liquid limit. The plastic limit is shown in Figure 8(b). A soil "thread" is rolled with the fingers to as small a diameter as possible without crumbling. Moisture content of the soil when the diameter of this smallest thread is ⅛ inch is termed the plastic limit.

The shrinkage limit is not of interest here. For those interested ASTM and AASHO have adopted standard procedures.

Classification Systems

There are numerous methods of soil classification that have been devised, accepted and used in the soil engineering field. In fact, almost every soils engineer develops a system somewhat unique to his own operations. However, three sys-

TABLE 2—CLASSIFICATION OF HIGHWAY SUBGRADE MATERIALS

(With Suggested Subgroups)

General Classification	Granular Materials (35% or less passing No. 200)							Silt-Clay Materials (More than 35% passing No. 200)			
Group Classification	A-1		A-3	A-2				A-4	A-5	A-6	A-7
	A-1-a	A-1-b		A-2-4	A-2-5	A-2-6	A-2-7				A-7-5, A-7-6
Sieve Analysis, percent passing:											
No. 10	50 max.										
No. 40	30 max.	50 max.	51 min.								
No. 200	15 max.	25 max.	10 max.	35 max.	35 max.	35 max.	35 max.	36 min.	36 min.	36 min.	36 min.
Characteristics of fraction passing No. 40:											
Liquid limit				40 max.	41 min.	40 max.	41 min.	40 max.	41 min.	40 max.	41 min.
Plasticity index	6 max.		N.P.	10 max.	10 max.	11 min.	11 min.	10 max.	10 max.	11 min.	11 min.*
Group Index†	0		0	0		4 max.		8 max.	12 max.	16 max.	20 max.
Usual Types of Significant Constituent Materials.	Stone Fragments, Fine Gravel, and Sand			Silty or Clayey Gravel and Sand				Silty Soils		Clayey Soils	
General Rating as Subgrade	Excellent to Good							Fair to Poor			

Classification Procedure: With required test data available, proceed from left to right on above chart and correct group will be found by process of elimination. The first group from the left into which the test data will fit is the correct classification.

* Plasticity index of A-7-5 subgroup is equal to or less than L.L. minus 30. Plasticity index of A-7-6 subgroup is greater than L.L. minus 30.

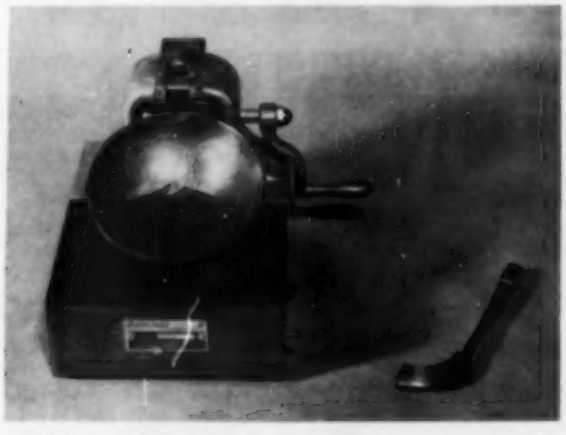
† See group index formula (Equation 8) for method of calculation. Group index should be shown in parentheses after group symbol as: A-2-6(3), A-4(5), A-6(12), A-7-5(17), etc.

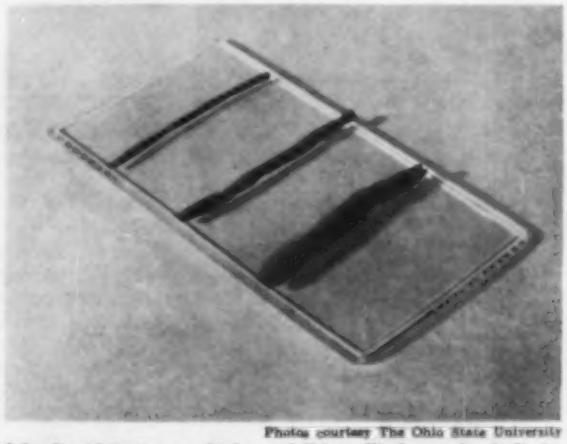
tems can be described to show the role of the soils tests in classification. The reader is reminded that the purpose of classification is discussion and broad generalization and that accurate values of the engineering properties are not produced. A soil can be classed and described by the appropriate designation. Familiarity with the system and with the soils in an area will provide some common basis for discussion. The three systems to be described are: (1) Highway Research Board; (2) Unified Classification System; and (3) Pedalogic Classification. The three have been chosen because of their basic differences as well as the fact that they are frequently used. No effort will be made to give details as to classification—rather, the principle utilized will be discussed.

Highway Research Board System

Essentially, the new (1948) system proposed by a committee of the Highway Research Board consists of a revision of the original classification utilized by the highway departments and developed by the Bureau of Public Roads. For those familiar with that original system, the new one is quite simple to understand. In Table 2, the original and the revised system indicate a basic grouping into (1) granular materials—A-1, A-2 and A-3; (2) silty soils—A-4 and A-5; and (3) clay soils—A-6 and A-7. In the original system, A-8 was utilized to designate highly organic clays, peat and muck.

It will be noted from Table 2 that a basic division is made on the basis of the percent passing the No. 200 sieve. The only additional data on





Photos courtesy The Ohio State University

● **FIG. 8. Equipment for consistency tests. Device at left is used for liquid limit test. Right, soil "thread" shows plastic limit.**

grain size that are required are the percentages passing the No. 10 and No. 40 sieves. The use of gradation is to identify and divide the granular materials into A-1, A-2 and A-3. All other soils are in one group insofar as gradation is concerned. The final breakdown into the total of 12 groups is on the basis of liquid limit, plastic limit and P.I.

The major change from the old B.P.R. system was the elimination of several tests such as the field moisture equivalent, shrinkage limit, and a complete hydrometer analysis. Another change was the addition of an index that follows the major group designation as a parenthetical number; i.e., A-7-6 (17). The index value is intended to show the degree of plasticity—the higher the index, the more plastic is the soil. The group index (GI) is derived from charts developed from the following empirical equation:

$$GI = 0.2a + 0.005ac + 0.01bd \ldots 8$$

The constants a,b,c, and d are based upon percentages passing the No. 200 sieve (a and b), the liquid limit (c), and the PI (d).

Unified Classification System

This system was developed by Arthur Casagrande and adopted in 1952 by the Corps of Engineers and the Bureau of Reclamation. The system is not unlike that for the HRB in that the gradation is the major basis for delineation, and that only the percentages passing specified sieves (No. 4 and the No. 200 in the Unified System) are utilized. However, the group designations are in capital letters that suggest the soil type rather than the letter "A" followed by numerals. In addition to the gradation, the sole basis for classification in the Unified System is an empirical equation based upon the limits. Rather than using an index, however, the second letter in the grouping is defined by the liquid limit and the P.I.

Pedalogic System

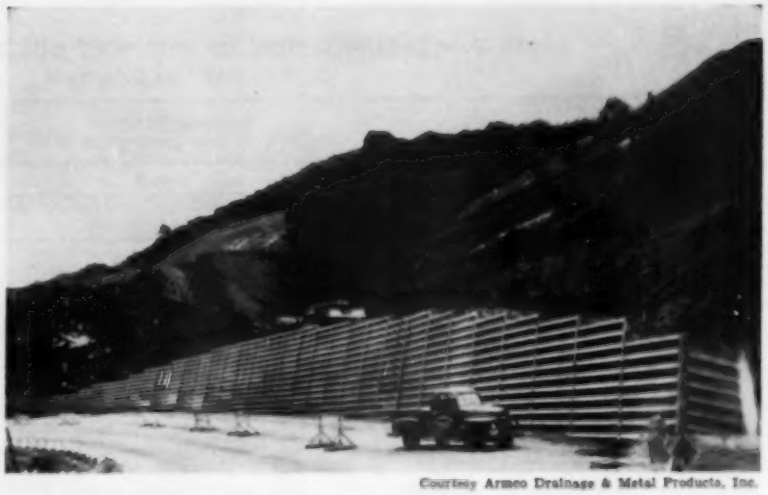
The soil science field developed a classification system related to land use for agricultural purposes. As early as 1928, the Michigan Department of Highways adopted the system and applied it empirically to their highway problems. The basis for the pedalogic system is a soil series based principally upon grain size. A triangular chart is used to show the gradual change from sands-to silts-to clays. The procedure requires a complete gradation. In addition, a series of variables such as permeability, ground slope, and parent material from which the soil is derived are utilized to divide the soil of the earth into areas of similar soil. The groups are designated by names and soil series types such as Miami silty clay or Fox clay loam. The system is integrated nationally. Much of the United States has been so mapped.

In practice, very little actual mapping of this type is accomplished by the engineer. Usually a map is available and the soil areas established. The major problem for those utilizing pedalogy in engineering is describing the soil areas in terms of behavior. In Michigan, the use is based upon studies of the performance of structures (principally pavements) in the areas, and gradual evolution of a satisfactory empirical or experience record.

Other states, the Bureau of Public Roads, the Corps of Engineers, and other agencies have attempted to describe these soil areas in terms of the gradation and limits. Airphoto interpretation and engineering soil mapping can be greatly aided by pedalogic maps.

The most severe criticism of the use of the pedalogic system is in over-classification. Another criticism is that proper interpretation and integration has not been made for the deeper soil strata. Thus, divisions indicated as important to the agronomists may exist in the top twelve inches—the material normally wasted by the engineer.

It is the writer's opinion that the real purposes for engineering classification are best met by the aerial concepts of the pedalogic system and that in time the system will continue to grow in use in the engineering field. Since very few classification tests are required, the cost of the soil work can be restricted to the specific performance property that is desired. Empiricism for minor structures might well be based upon pedalogy.



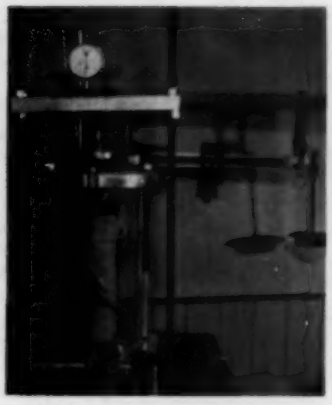
Courtesy Armco Drainage & Metal Products, Inc.

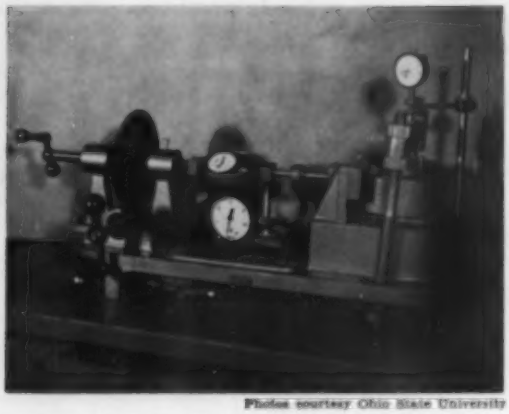
● **FIG. 9 Bin-type retaining walls may be used where natural soil stability is inadequate. Knowledge of soil mechanics helps determine need for such structures.**

STRENGTH PROPERTIES

The three engineering properties of soils that are of interest here relate to shear, settlement, and permeability. The last of these three is included with strength more because of convenience than because it reflects strength. Questions dealing with permeability are concerned with loss of water (as through a dam) or collection of water (as in a drain). Moisture flow has an effect on strength but this factor is accounted for by means other than permeability.

As stated earlier, the only two basic problems in soil engineering are those of (1) stability (shear failures) and (2) settlement. Due to the difficulties of integrating theory and practice, many techniques based upon experience have evolved to solve these two problems simultaneously. These empirical methods include the CBR, cone penetrometer, plate loading tests, penetration tests, etc. In many instances, use of empiricism is superior to the theoretical, and offer





Photos courtesy Ohio State University

● **FIG. 10(a), left. Laboratory arrangement for the unconfined compression test. FIG. 10(b), center. In the tri-axial shear test the rubber-encased soil sample is surrounded by a uniform pressure. FIG. 10(c), right. Direct shear equipment applies a horizontal shear load and a load-deflection curve is developed. A vertical load on sample gives uniform pressure effect.**

the only possibilities in some cases where specialists are not available, or the economics do not justify their being used. On occasion due to the complexities, the empirical approach is the only one. For the past hundreds of years, this last fact has been true for the design of pavements, particularly flexible pavements.

In the following pages, the underlying principles of the tests will be described. As has been true in the previous discussion, detailed theory and method are outside the scope of this article. In fact, analytical treatment of stability and settlement problems should be left for the specialist. However, a comprehension of the aims and the factors involved are not too difficult to grasp.

The most important general statement relative to obtaining a soil strength property is that *the conditions of the test must be comparable to the conditions that will exist in the structure.* This is particularly true of unit weight, moisture content, soil structure and rate and duration of loading. The soil structure effect refers to the change in strength properties that result from destroying or disturbing certain natural strength developed by nature within the soil mass. Undisturbed samples, or samples removed by the use of metal tubes from the ground are used when practicable. For embankments or other structures when the soil is recompacted, laboratory procedures attempt to duplicate the structure that will be developed by the rollers.

Shear Tests

The only major source of resistance in a soil structure that will resist instability is that of shear—no significant tension can be withstood. As is true for concrete and steel, soil either fails in shear under compression forces or merely "contracts" or "consolidates". Under structural foundations, soil will compress, thus bringing about settlement, or will shear, leading to tilting or collapse of the structure. In order to determine the unit shear strength, several types of tests can be used: (1) tri-axial shear, (2) direct shear, or (3) vane shear. Typical equipment for these tests is shown in Figure 10.

The Coulomb equation for shear is as follows:

$$s = p \tan \phi + c \quad \ldots \quad (9)$$

where:

- s = shearing resistance in lbs. per sq. in.
- p = normal force in lbs. per sq. in.
- ϕ = angle of internal friction in degrees
- c = cohesion in lbs. per sq. in.

The purpose of the tri-axial and the direct shear tests is to determine the values for ϕ and c which are relatively constant for a given soil structure and moisture content. Assuming that soil will shear along a curved or straight surface, the normal force is the component of the total force that acts perpendicular to the surface of shear. Cohesion can be pictured as an inherent tensile force that arises from the attraction that exists between very small particles, and has a value of zero for material composed of particles larger than very fine sand. In recent years a more complex explanation of cohesion has been evolved, but the foregoing will permit a sufficiently accurate picture for the moment.

Friction has the conventional meaning of fundamental physics; i.e., the resistance between two objects to sliding one over the other is directly proportional to the weight (Figure 11) and independent of the contact area. If the cohesion is equal to zero for granular materials then:

$$s = p \tan \phi \quad \ldots \quad (10)$$

For fine-grained soils, ϕ approaches zero, and for some cases, the following can be assumed:

$$s = c \quad \ldots \quad (11)$$

For the tri-axial and direct shear tests, three samples that are as nearly identical as possible are loaded to failure. The tri-axial test resembles a standard cylinder test for concrete except that the soil

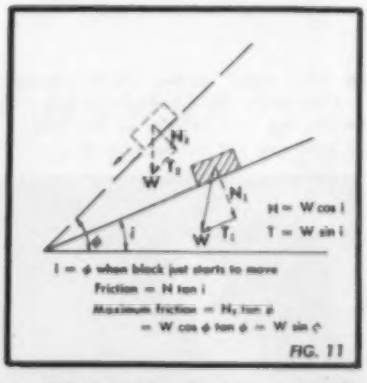
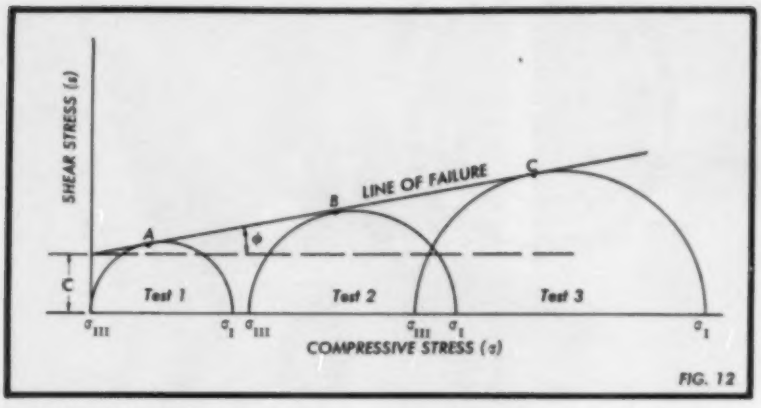


FIG. 11

● **SHEAR tests use the principles of frictional resistance shown above.**

sample is surrounded by a rubber membrane and a liquid or gas contained in a chamber applies a pressure around the rubber-encased soil sample. This lateral pressure is held constant while a compressive force loads the soil to failure. The lateral



● **DIAGRAM of Mohr's circle theory is used to determine values of "c" and "φ".**

pressure is usually designated as σ_{III} and the compressive strength as σ_I. Each of the three samples is tested to failure under different lateral pressures, which may result in three different compressive stresses at failure. To obtain φ and c, a plot similar to Figure 12 is developed for the three tests. By drawing a line tangent to the three circles, the "line of failure" is developed. The equation for the line of failure is equation (9). Thus, it can be seen that shearing resistance increases linearly as the normal force increases, whereas c is a constant—the shear value under zero compressive stress. Actually c is a tensile force. The line of failure would be essentially horizontal for clays, equation (11), and would go through the origin for granular materials, equation (10).

The direct shear test consists of measuring the resistance to shear across a plane surface in a block of soil, as shown in Fig. 13. A different vertical pressure is used for each of the three specimens. A greater force is required to shear each of the specimens except for clay soils. The three points A, B, and C in Figure 12 represent the data for a direct shear test. The circles are not needed for the analysis of the direct shear test. The results of the two tests should be comparable for the same soil, but rarely are, probably because of differences in shear surfaces.

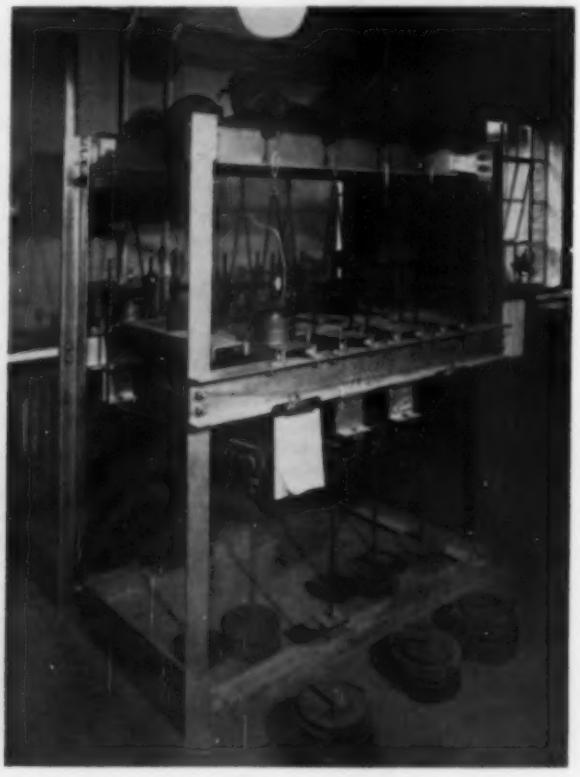
The laboratory vane shear test is patterned after the field vane test which is discussed in Part III. Suffice to say, the total shear strength, s, is obtained directly for specific conditions of normal pressure.

Settlement Properties

The second major soil problem is concerned with the determination of how much a given soil will compress under a load applied. In this section, the principles of the laboratory test that is used will be discussed and the application of the results will be covered in the section dealing with design in Part II.

Estimating settlement is probably the least accurate result of any of those obtained for soil engineering problems. Where preciseness is required, a specialist is most essential. The theory applied is termed the "consolidation" theory and is applicable only to special cases where there are saturated, soft clays, under the compression of the load from the structure. For

● **FIG. 14(b), at right, shows laboratory equipment for the consolidation test. In this test, undisturbed samples of soil are subjected to heavy loads through the lever system in the lower part of the frame. Rate of settlement is observed for each increment of vertical load applied to the soil sample.**



● **FIG. 14(a), below, shows circular rings which contain soil samples while vertical load is applied. Porous plates at the top and bottom of the specimen permit moisture to be squeezed out during test. Dial indicators show settlement.**

granular materials, the problem is not too severe, but for non-saturated fine grained soils, and for saturated clays that have been heavily precompressed (by such weights as glaciers would have applied) no satisfactory way of predicting rate of settlement is available. However, these materials do not pose as serious a problem as do those for which the consolidation theory applies.

As stated earlier, saturated clays to which a load is applied tend to compress and the soil grains to be forced closer together. However, the water in the voids prevents this action immediately, and a pressure to move the water is established. Unfortunately, in clays, the permeability is low and the water drains very slowly. In comparison, for silts the permeability is greater and the problem does not exist for more than a few hours and the water pressure is quickly dissipated.

The total problem is more complex than suggested by the preceding simplification. However, all of the elements of the physical description of the theory are present, and the conduct of an investigation can be understood.

An increment of load is applied to the specimen and no additional load is applied until such time as the settlement has ceased. A second increment of load is then placed on the sample, followed by additional increments until the desired stress has been applied to the sample. Two types of data are desired from the test; one is related to the total settlement and the second is concerned with the rate of settlement. Most of the problem lies with the rate

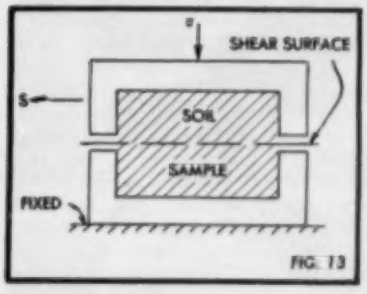


FIG. 13

● IN THE direct shear test, both vertical and shearing forces are used.

question. The usable data from the test are in the form of coefficients which are utilized directly in computing total settlement and rate of settlement. These are discussed further in Part II.

In the laboratory, it is essential that an undisturbed sample be tested. This sample is compressed under confined conditions; i.e., no lateral expansion. Typical equipment is pictured in Figure 14. The principal objections to the laboratory test lie in the difficulty in obtaining undisturbed samples to represent a total layer (sometimes several feet in thickness); also, the sample that is tested is less than one inch in thickness. There is some question as to the concept that water will be drained under the natural field conditions from a material as impermeable as clay in the same manner as it does in the laboratory.

Methods for obtaining settlement by techniques other than those based upon the laboratory consolidation test will be discussed in Part II under a discussion of field tests for design.

Summary

In the preceding section, the soil properties that are essential to an understanding of the basic behavior of soils under stress have been described. Subsequent sections that deal with design and construction problems will incorporate no new concepts but will merely apply these relatively few principles of soil behavior. No effort will be made to make 24-hour specialists, but the basis for an understanding and the development of the ability to discuss intelligently with the specialists has been and will be provided.

Editor's Note: Parts II and III of this series will appear in the March and April issues.

For Easier Refuse Handling and Disposal . . .

Will Baling Be The Answer?

JEAN L. VINCENZ
Director of Public Works,
County of San Diego, California

METROPOLITAN cities and counties are encountering rapidly increasing costs for refuse disposal whenever an existing sanitary fill site is completed and a new one must be found and opened. In nearly all instances the new disposal site will be considerably farther distant from the pick-up point, thereby increasing ton miles and cost. This is always a problem to public works officials, the city manager and the council that must raise the funds for refuse collection and disposal.

So great is this problem becoming that some of the big cities are giving increasing consideration to the construction of new, engineeringly designed, and strategically located incinerators; and this may well be the answer for some. The fact cannot be overlooked that refuse collection and disposal is an integrated problem and long hauls of refuse cost money, regardless of whether the charge is made against collection costs or disposal costs.

In an attempt to meet these facts, many large cities have installed, are installing, and are considering the installation of properly designed and carefully located refuse transfer stations. The manufacturers of refuse packer trucks are producing them in mammoth sizes in their endeavor to best serve the cities and meet these problems. Greater emphasis is being given to compaction by these manufacturers in order to get the largest possible volume of loose refuse into the truck for the long haul to the transfer station or to the disposal site. Loads of increasing volume and weight are being hauled from the transfer station to reduce the unit cost of transport to the disposal site.

When a new sanitary fill site must be opened the problems really accumulate. In fact, the city official can be quite sure that some irate homeowner is going to get a petition started protesting the new location because the trucks going to that site will pass his property.

Here is an idea submitted for consideration. Purposely, it's presented in brief form. Actually, it's as simple as A, B, C.

At the refuse transfer station, install a baler that will compress and then bale—possibly with baling wire or metal straps—a quantity of refuse into a bale somewhere between the size of a bale of hay and a bale of cotton.

Load the bales onto a low-boy or other suitable trucking conveyance that can haul a large pay-load to the refuse disposal site.

At the disposal site, prepare an area to receive the bales which are to be stacked side by side and on top of each other in the ordinary method of stacking baled hay. Covering of earth to protect against rodents and fire, and to provide a smooth top surface, will be placed according to plan.

That's a thumbnail sketch of the idea; so now for some details in order to consider a few of the problems.

1. The compressor must be strong enough to compress sufficient refuse to do some good. It should be able to flatten cans and break bottles. Articles such as ice boxes, refrigerators, and bed springs probably should be hand picked for separate disposal.

2. The compressing and baling operation must be relatively rapid in order to obviate an undue increase of storage capacity for the unbaled refuse. With larger operations, several compressors will probably be required.

3. Baling or binding material should be strong enough to retain the refuse in the compressed condition and enough of it in quantity to prevent any considerable loss from the bales in the handling processes. Some of the experiments that have been conducted indicate that this is not a serious problem.

4. At the disposal site, trenches with vertical sides on the starting side could be desirable but not at all necessary. It seems desirable that the bottom of each section be relatively level.

5. The bales, of course, would be stacked with the bales interlocking. The height of stacking would quite naturally vary with the width of the stack.

6. At intervals determined by good practice, it seems advisable to start a new stack, leaving two or three feet between stacks, which area should be filled with earth and compacted. These would provide rodent-breaks and firebreaks.

7. The amount and timing of covering the top of the stack with earth also would depend on good operating practices and uses to be made of the fill when completed.

Experimental Work

Experimental work along the lines of the idea described has been very limited. The U. S. Public Health Service Test Station at Chandler, Arizona, utilizing limited funds available, made some rather sketchy tests in connection with compression and baling. The County of Los Angeles reports that at one time it did a certain amount of baling but experienced difficulty in trying to handle the bales at the disposal sites with the bulldozers. There is considerable information available concerning the weight of a cubic yard of refuse. It seems to vary between 300 and 500 pounds per cubic yard except when under compression in a compactor truck when the weight per cubic yard is somewhat higher. However, much of this effect is lost when the refuse is discharged from the compactor truck. On the other hand, ordinary bales of waste paper are reported to weigh about 1200 pounds per cubic yard with magazines running as high as 2000 pounds.

It is recognized that there will be problems in designing compressors and balers that are reasonably rapid, efficient and not too costly; but as a starter there are many balers available today for compressing and baling tin cans.

Potential Advantages

It may be desirable to list a few of the advantages of this scheme, though many of them seem fairly obvious, such as: Greatly reduced cost of haul; longer term of use for a disposal site; much less blowing of papers at disposal site; neatness of operational appearance; etc. But some of the additional advantages—the intangible ones that have to do with public relations, the mayor and the city council—can be even more important, and if necessary these intangible advantages could well justify adoption of this scheme even if it did cost a little more. There seems little reason why bales of refuse as described above could not be piled in orderly stacks in depressed areas or gullies in the city park or in some of the playgrounds or even school grounds in order to obtain level playing areas rather than employ expensive movement of earth fills. It is even possible that such fills might be requested. Certainly, it appears that it should be possible to obtain disposal sites much closer to the central city or the city's edge if a plan such as outlined is utilized.

Probably the fundamental principle of this scheme is to parallel the farmer's art as he stacks his hay. Utilizing his methods, the smallest amount of acreage is going to be required and certainly this means that a disposal site will last much, much longer than under the conventional method of sanitary landfill. Of course, variations to meet local conditions must be expected. Some refuse packer equipment manufacturers may come up with a practical method for baling right in the collection vehicle. But the most important parts of the idea are: 1) To place more refuse in a given disposal site; and 2) to utilize sites requiring considerably less haul distance and which would not probably be acceptable to neighbors if conventional sanitary landfill methods were used.

Maybe this is just another dream, but it is also possible that as result of the careful study by the excellent research men in the refuse disposal field the total costs will be found to be much less than may be expected.

Jean L. Vincenz is Director of Public Works for San Diego County, Calif., a position he has held since 1947. He is currently President of the American Public Works Association. During the war he was Chief of the Maintenance and Utilities Branch, Repairs and Utilities Division, Office of the Chief of Engineers, where he was instrumental in developing the sanitary landfill method of refuse disposal to meet the needs at army installations. Before the War, he was City Engineer and Commissioner of Public Works for Fresno, Calif., where he was one of the early developers of the modern sanitary landfill. He is a registered professional engineer and a member of ASCE and a diplomate of the AASE.

● FREDERICKSBURG'S new sewer cleaning equipment now operates on a regular scheduled program. As a result, complaints about stoppages have practically ceased.

NEW CLEANING MACHINES

CURE SEWER COMPLAINTS

CLIFFORD RUSCH,
Administrative Assistant, Office of the City Manager, Fredericksburg, Virginia

AS ANY municipal supervisor knows, citizens' complaints are more than just aggravating. They usually mean either the disruption of a carefully prepared work schedule or expensive overtime work. In addition, the situations leading to complaints are the worst possible public relations. Most people recall vividly and vocally the occasions when municipal services are inadequate or unsatisfactory. They less frequently are conscious of the normally good service they receive.

In Fredericksburg, Virginia, the Public Works Department, under the direction of City Engineer Charles H. Pierson, has almost completely eliminated perhaps the most unpleasant cause of citizens' complaints. With the initiation of a scheduled program of regular sewer cleaning and the purchase of specialized sewer cleaning equipment, the number of telephone calls from anguished citizens whose basements are awash with storm water or decidedly malodorous sanitary sewage has been reduced, quite literally, from a flood to an almost insignificant trickle. While Fredericksburg's program is not unique or as extensive as in many municipalities, we believe that the extent of our capital investment in equipment and the extent of our program is somewhat unusual among cities of Fredericksburg's population (15,000). We have found that our initial expenditure is completely justified by operational economies and improved service, and we hope that the narration of our past problems and the solutions we found will be of value to other communities.

Past Problems

Prior to the initiation of the present sewer cleaning program, the Public Works Department was plagued by clogged sanitary sewer mains and storm drains. On the average, three calls per week were received complaining of clogged sanitary sewers, and, with every heavy rain, whole streets of residents would call to complain of blocked storm drains which were causing flooded streets and basements. All sewer cleaning was handled on a complaint basis which resulted in disrupted work schedules and overtime work. The cleaning was done with a manually operated sewer rod, which, as we now know, was completely ineffective in many cases. Many repeat calls were received for sewers which were clogged but which had been "rodded out" only a short time before. It appeared that some storm drains and sanitary sewer mains were really inadequate and that they would require eventual replacement with larger mains.

In an effort to eliminate complaints resulting from the silting up of the city's largest concrete box culvert, Mr. Pierson contacted the Ace Pipe Cleaning Company. The results of the cleaning operation conducted by this organization were an "eye-opener". In one 2,400-foot section of this concrete culvert, about 100 cubic yards of refuse were removed. Several short sections of sanitary sewer which had been rodded out innumerable times yielded the same type of results. The refuse removed included everything from silver spoons to coke bottles and bricks. The inescapable conclusion was that the manually operated sewer rod often merely opened a small and temporary channel through clogged sewer lines. After calculating the cost of our existing sewer "cleaning" operations, the City Engineer placed an order for the basic cleaning equipment used by the Ace Pipe Cleaning Company.

Cleaning Equipment

Basically, the sewer cleaning equipment which was purchased from Flexible, Inc., consists of two units. Each unit consists of a winch driven by a 9-hp gasoline engine. One unit is placed at the manhole immediately above the stoppage while the second unit is set at the first manhole downgrade from the

stoppage. A cable with a bucket attachment is run between the two manholes and attached to the winches. The clamshell type bucket is pulled back and forth through the sewer main until all debris has been removed. Normally, cleaning operations are started with a small diameter bucket. As the stoppage is reduced, buckets with progressively larger diameters are used until the sewer main or storm drain is completely cleaned. Various other cleaning attachments such as "porcupine" brushes were also purchased to provide complete cleaning operations. The total cost of the equipment and attachments was $4,600.

Cleaning Program

Our cleaning equipment was placed in operation in October, 1957. Initially, the Public Works Department concentrated on cleaning the storm drains and sanitary sewers which had given rise to the most complaints. This phase of the program was quite extensive and revealed that some "dead-end" sections of storm drains were completely stopped up. Several sanitary sewers, which were restored to complete capacity by cleaning, had been reduced an estimated 50 percent of capacity by debris. All of these trouble spots are now flushed out monthly with a tank truck. Any storm drains or sanitary sewers are immediately cleaned with the bucket machines, and the Public Works Department is gradually working into a program wherein all sewer mains and storm drains will be cleaned regularly.

Our large box flume for storm water receives a periodic "walk through" inspection and is cleaned as necessary. The cleaning of this flume is done with a somewhat original device—a regular farm scoop is hand guided while it is pulled by a cable attached to the winch of the sewer cleaning machine. The cleaning program has been greatly facilitated by a complementary program initiated by the City Engineer's Office. A group of employees are bringing the intersection plat sheets up to date by visually checking each street intersection in the city. These plats show the location of each manhole and valve for city utilities, and whenever a storm drain or sanitary sewer stoppage is noticed it is immediately reported for corrective action.

● LOAD OF silt in bucket is discharged when tension on lead cable is released.

Results

After more than a year of operation, the sewer cleaning program, which was made possible by our new equipment, has yielded the following results:

1) Citizens complaints caused by stopped up sanitary sewers have decreased from an average of three per week to less than one per month.

2) Complaints stemming from blocked storm drains have become a rarity. Only two or three such complaints have been received in the last year. Formerly, every large rain resulted in a host of irate calls for assistance.

3) The reduction in complaints has almost eliminated disrupted work schedules, emergency night calls, and overtime work caused by clogged sewer mains. The Public Works Department estimates that the economies resulting from being able to schedule sewer cleaning operations and the elimination of repeat calls, overtime, and disrupted work schedules should pay for the sewer cleaning equipment within five years.

4) The sewers formerly believed to be inadequate and in need of eventual replacement with larger mains have proved, after a thorough cleaning, to have perfectly adequate capacity. It is impossible to assess the financial savings resulting from the avoidance of unnecessary sewer reconstruction. However, even a modest sewer main project of approximately 1,000 feet of pipe can equal or exceed the total cost of our sewer cleaning equipment.

5) Finally, while it is unlikely that a large percentage of Fredericksburg's citizens are aware of our improved service since all of the work is underground, certainly those citizens formerly plagued by flooded basements have been afforded welcome relief from a most annoying and unsanitary situation.

In conclusion, our experience leads us to believe that many cities of Fredericksburg's population size might well investigate the desirability of purchasing specialized sewer cleaning equipment. Fredericksburg has found that our expenditures for this equipment will be justified purely by the operational economies and efficiencies made possible by the equipment, and any community plagued with apparently inadequate sanitary sewers or storm drains may be pleasantly surprised to find that a thorough sewer cleaning program will eliminate their problems.

● IN THIS new incinerator, refuse is burned at the rate of 12½ tons an hour and only four men are required for operation.

INCINERATOR NEAR RESIDENTIAL AREA IS COMMUNITY SHOWPLACE

A NEW municipal incinerator that burns up to 12½ tons of refuse an hour without producing objectionable odors or dirt is now serving 50,000 residents of two southeastern Pennsylvania communities. The plant was built for the Whitemarsh Township Authority, with Glace & Glace, Inc., of Harrisburg, Pa., as consulting engineers. Incineration equipment was designed and installed by Dravo Corporation, Pittsburgh, under a sub-contract from William H. Gill, of Lansdowne, Pa.

Operated by only four men, the new incinerator is of the horizontal, continuous type. It is so situated and designed that burning material moves through the furnace on a gravity flow basis. Because of its high degree of automation, operating personnel are limited to a supervisor, who controls the entire incineration process; a weighmaster-loader; a conveyor operator, and a man to load and drive a truck that carries off non-combustible residue. These minimum personnel requirements contribute substantially to the plant's low operating cost.

The incinerator is located some 20 miles northwest of Philadelphia on 40 acres of rolling ground which also is the site of a sewage treatment plant for the Whitemarsh Sewer District. In addition to serving 12,000 Whitemarsh residents, the incinerator also burns garbage and rubbish for 38,000 residents of nearby Cheltenham Township under an agreement setting a fixed price per ton.

Treated effluent from the sewage plant is used in the incinerator for cooling purposes and in the wet scrubber for fly ash and air pollution control. Recirculation limits actual water consumption to only 1,000 gallons per ton of refuse burned.

Although the plant has a 24-hour capacity of 300 tons, it is burning only about a third of that amount at the present time, operating on one eight-hour shift. Thus there is ample provision for handling any probable future increases in the refuse disposal requirements of the area it serves.

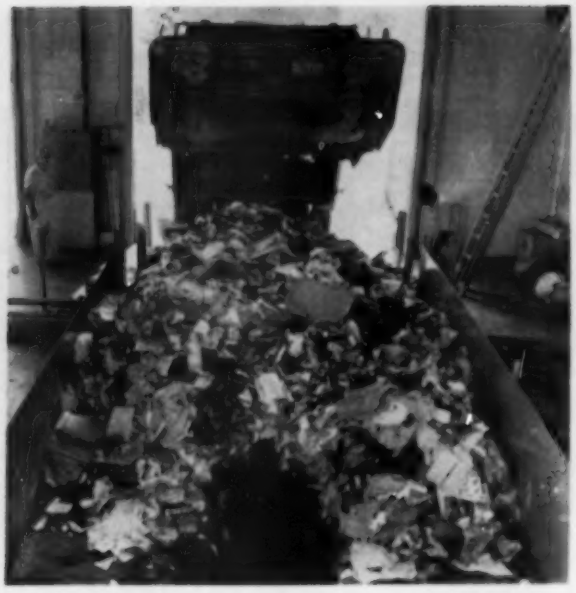
Construction

The furnace walls consist of an outside steel casing, mineral wool insulation, fire brick refractory and a piping system, known as a water-wall, which circulates cooling water immediately inside the refractory. The water-wall has these advantages: 1) It keeps the furnace walls constantly at temperatures below the normal slagging point of the refuse ash; 2) it makes possible shutdown of the furnace without the long cooling-off period necessary in other types of incinerators to prevent deterioration of the refractory; 3) it permits burning of material at high temperature, thus assuring more complete combustion and odor elimination.

All components of the incinerator are enclosed, except the truck weighing platform. The weighmaster's office, inside which are taken the scale readings, is located between the outdoor scales and the indoor unloading area so that one man can supervise both weighing and unloading. After the weighing, a truck enters the main building, stopping over one of two slotted floor positions. The refuse is then dumped and either falls through the slot to the storage conveyor or remains piled on either side of the slot between two steel barriers. When the truck is driven away, the pneumatically - operated barriers slide toward the slot from either side, pushing all remaining material onto the conveyor.

The storage conveyor consists of two 50-ton capacity oscillating hoppers, side by side but independently controlled. When the hoppers are oscillated, by means of electrically-driven eccentrically weighted rotors, the material moves forward into two hydraulic ram-type feeders, which charge it into the incinerator furnace. The feeders operate automatically on a controllable time cycle and are so arranged in conjunction with the furnace gates that a constant air seal is maintained at the charging entrance. An inclined

● TWIN 50-ton capacity oscillating hoppers. When these are operated, refuse flows to feeders which charge furnace.



● REFUSE is dumped into storage conveyor through slots in the floor. Enclosure prevents refuse from blowing about.

reciprocating stoker grate tumbles the material inside the furnace so that maximum surface is exposed to the flame. At the same time a forced draft through the grate and an over-fire air system aid in combustion.

As the incineration cycle is completed, ash, residue, tin cans, and other non-combustibles are discharged into a quenching tank, and the residue is drawn along the bottom of the tank under an air lock by a chain-driven drag-out conveyor which then lifts the material up to receiving hoppers for removal to a sanitary fill.

Furnace gases are first cooled in banks of water sprays and then passed upward through a wet scrubber where solid particles are washed out. These particles also drop into the quenching tank and are carried off with the non-combustible residue. Induced draft fans pull the gases up through the scrubber and out the stacks. Since the typical stack discharge is odorless steam, it has been possible to eliminate the tall stacks common to incinerators of the past and to replace them with much shorter stacks.

The building exterior and the landscaping have been designed to blend harmoniously into the residential area in which the plant is located. This precaution, in addition to the effective odor and air pollution control, have made possible the construction of a new school building less than 500 yards from the incinerator.

Construction cost of the incinerator was $825,500, or about $2750 per ton of capacity. It was financed by the Whitemarsh Township Authority through a $4,000,000 bond issue, which also covered the township's new sewer system and sewage treatment plant. The Authority consists of five members appointed by the township board of supervisors.

Begun in the spring of 1958, construction of the incinerator was completed in approximately 11 months, although some subsequent alterations were made as the result of operating experience during the break-in period.

FLOOD CONTROL
on a Limited Budget

DAVID B. BENHAM,
Senior Partner,
Benham Engineering Co. and Affiliates,
Oklahoma City, Oklahoma

DEEP Fork Creek has its source in northwestern Oklahoma City. It runs southeasterly through the Meridian Golf Course to about Thirtieth and Venice Blvd., and continues in a northeasterly direction until it empties into Belle Isle Lake. In 1945, the area was sparsely developed and the creek flowed intermittently, flooding pastures once in every 10 or 15 years. Rapid residential development along the creek upstream from Belle Isle Lake resulted in increased runoff in the 14-sq. mi. drainage area. Over a period of years, considerable silting of the Belle Isle cooling basin also occurred. In 1955, major flood damage occurred in these developed areas and it became necessary to take steps to control flooding. In December, 1955, the citizens of Oklahoma City approved a bond issue covering, among other items, a one million dollar fund for the Deep Fork Relief Project.

Early the next year the city council formally employed the Benham

● BELLE ISLE Lake is a cooling basin for power plant at right. New triple barreled outlet structure shown in center.

● AUTOMATIC float controls actuate six Limitorque gate lifts which are electrically operated; no attendant is needed.

Engineering Company to prepare a detailed study and recommendations on the Deep Fork drainage system. Preliminary field surveys of the entire stream bed from Western Avenue to Bethany were conducted. A detailed study was made of available rainfall data and flood records. Rainfall intensity frequency curves were compiled from the Weather Bureau records at the old Classen Station Observatory and the Will Rogers Airport Observatory in Oklahoma City. These records covered rainfall for periods from 2 to 100 years.

In making design computations, the entire 14-sq. mi. drainage area was broken down into smaller areas. The runoff for each individual area was computed by the rational method and a new channel was sized by the Manning Formula. The design storm flow at Belle Isle Lake was determined to be 13,700 cfs for the fully developed drainage area.

The flood control problem resolved itself into three parts:

1) Upstream from Belle Isle Lake, channel carrying-capacity was inadequate to cope with the increased runoff resulting from residential developments under relatively light rainfall conditions.

2) Drainage structures and bridges along the creek channel were no longer adequate in design to carry off flood waters, and thus were contributing backwater flood effects to upstream property.

3) The silting effects downstream in the vicinity of Belle Isle had greatly reduced the capacity of the lake itself. Spillway capacity was inadequate to control the backwater flooding effects of the increased runoff from storms of the magnitude encountered in 1955.

In June, 1956, representatives of the engineering firm met with city officials for the purpose of outlining a master plan for the ultimate development of the entire drainage area above Belle Isle Lake.

Several solutions to the problem were proposed, such as increasing the spillway capacity of the Belle Isle Dam, lowering and lengthening of the spillway, installing flood gates at the dam, or constructing a bypass channel around Belle Isle Lake together with channel deepening and widening. The master plan adopted called for an ultimate expenditure of approximately $1,800,000, which was nearly $1,000,000 more than the funds available.

Lack of funds to carry out the master plan immediately dictated that it would have to be completed in phases as funds became available. Phase One of the project included portions of the master plan designed to give maximum flood prevention within the funds already available.

Outlet Structure

In lieu of a bypass channel around Belle Isle Lake, an outlet structure with automatic gates was designed. This structure consists of a triple 15 by 13-foot culvert equipped with six 8 by 10-foot Armco cast iron slide gates, six Limitorque electric operated lifts, an automatic float control and a headmultiplier float well. The elevation of the bottom of the six gates was set at 7 ft. below the bottom of the existing silt-filled pool elevation to allow natural degradation of the lake and increase culvert capacity with the additional hydraulic head.

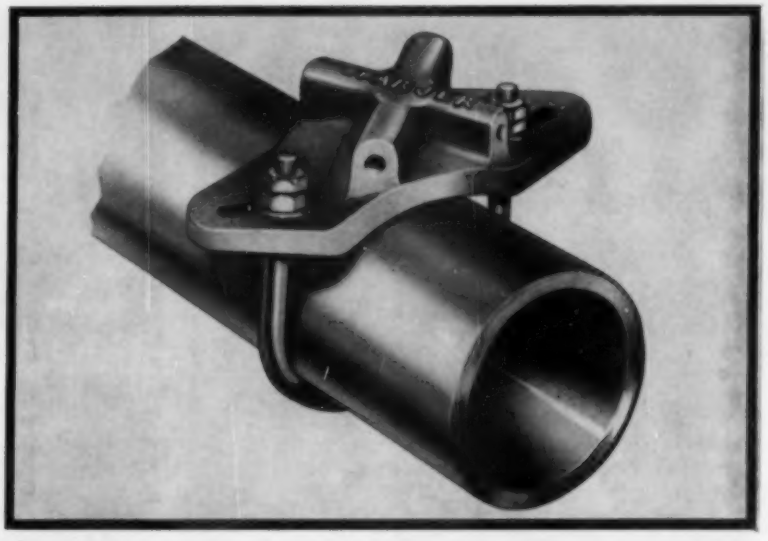
The function of this outlet structure is to limit the lake elevation to 2 ft. above the existing spillway crest for floods up to the 15-year design storm, which greatly reduces the upstream backwater.

To accomplish this, the last 6 inches of the 2-foot increment of the lake-level rise is multiplied eight times by the use of a combination rectangular notch weir and a circular orifice plate located in the float well. An automatic float controller was provided to actuate the Limitorque gate lifts in six increments with each gate going from fully closed to fully open in eight minutes. The head-multiplier float well insures positive action of the float by increasing the working differential and by damping out the effects of wave action.

Thus, the operation of the flood gates is completely automatic, dependent only on a sufficient flow into the lake to actuate the float mechanism. Operation of the gates requires no attendant during flood flows.

In the future when the bypass channel around the lake can be constructed, the gates on the outlet structure will be removed and salvaged, and an adequate culvert will be in place under Belle Isle Boulevard. Phase One also provided for the widening, deepening and straightening of the entrance channel into the lake. Portions of the channel were paved with concrete to increase velocities and lower the hydraulic grade line. An inadequate bridge at Mattern Drive was one of the chief causes of flooding in the area south of Mattern Drive. This bridge was removed and will be replaced at some future date when funds are available.

The low bidder on Phase One was the Boecking Construction Co. with a total bid of $768,924. Construction was supervised by the design engineering firm, on behalf of Oklahoma City. Del Bledsoe was designated as resident engineer on the project.



● SPARJER and saddle are cast in one piece and mounted, with neoprene gasket and stainless steel U-bolts, on the air header for efficient application.

AIR

APPLICATION IN THE ACTIVATED SLUDGE PROCESS

DOUGLAS E. DREIER,
Vice-president and Chief Engineer,
Walker Process Equipment, Inc.,
Aurora, Ill.

THE introduction of air (oxygen) into wastewater undergoing treatment is a prime requisite of the activated sludge process. Aeration of the liquid has been an integral part of the process since the activated sludge process was developed in 1916 and will continue to be important because the process depends on the availability of oxygen to the sludge floc.

In the past four decades, many studies have been made on the means of supplying oxygen by aeration. Two methods in particular have found favor: Mechanical aeration and diffused air aeration. This article is concerned with the latter system and the theory and development of new concepts in air diffusion equipment.

Basic Needs

In approaching the development of air diffusion equipment, three fundamental concepts must be considered. These are: Steps in the activated sludge process, gas solubility, and practicability.

Steps in Activated Sludge Process. Buswell (1) pointed out that there are six important steps involved in the activated sludge process: 1) Air must saturate the liquid immediately below the surface of contact, a very rapid reaction; 2) this dissolved oxygen must diffuse to the activated sludge particle, an exceedingly slow process; 3) the dissolved molecular organic matter must diffuse to the activated sludge floc, also a very slow process; 4) the colloidal particles must get to the activated sludge floc, but the actual change of position of colloidal particles in a liquid is practically nil; 5) the organic matter and oxygen must be taken up and worked over by the organisms in the floc, a rapid reaction; 6) the by-products of biological growth must diffuse away from the sludge floc or they will accumulate and poison it, also a slow process.

Considering that only two of these processes are rapid, that three are very slow and one practically zero, it is apparent that to make the process work, the slow steps must be speeded up. The best methods of accomplishing this speed-up is by stirring, an action which also provides new surfaces in contact with the air.

Gas Solution. Fair and Geyer (2) have pointed out that the absorption (solution) of gases in water is a function of 1) solubility of the gas, (solubility depends on partial pressure of the gas, temperature of the water, and concentration of dissolved matter in the water); 2) rate of solution (rate of solution depends on the degree of undersaturation, or supersaturation, of the water, temperature of the water, and exposure of the water to contact, i.e., the prevention of stationary films at the gas-water interface); and 3) rate of dispersion of the gas in water by molecular diffusion or by eddy diffusion with convection currents or agitation.

Practicability. Many authors have pointed out that to be practical, air diffusion equipment should be able to accomplish the desired stirring effect and bring about rapid absorption of oxygen at an economical power expenditure and high efficiency, with no loss of effectiveness over long periods of time and with low maintenance requirements.

Theoretical Considerations

The actual solution of a gas in a liquid takes place by diffusion action across a two-layer film at the interface of the liquid and gas. One of these layers is gas; the other is liquid. Passage of the gas through the layers is determined by the thickness of the film. If the solubility (amount of gas that can be dissolved in a unit volume of liquid) is low, as in the case of oxygen, then the passage of the gas through the liquid film layer is the controlling factor. Once the liquid film becomes saturated with the gas, the rate of transfer through it is controlled by

the diffusion of the gas into the surrounding liquid. This diffusion, as has been pointed out, is a slow process.

Studies (3,4,5) have shown that the smaller the bubble of air, the greater the rate of oxygen absorption because of the increased film surface area. On the other hand, larger bubbles travel upward faster through a column of water, causing an increased shear at the boundary level, which increases the oxygen transfer coefficient. However, if bubble rise is too rapid because of increased rates of gas input, then (unless special methods of prevention are used) a chimney effect is created, whereby the upward motion of the liquid entrained in the bubble wake, reduces the lateral diffusion of oxygen.

Carver (3) and others have shown that the rate of oxygen absorption is most rapid at the moment of bubble formation. Absorption during bubble rise in the liquid is fairly steady at a relatively low rate. Carver also believes that there is absorption as the bubble breaks at the surface and that this is responsible for some aeration from the atmosphere. Other investigators believe that there is relatively little oxygen absorption during bubble rise, and even less at the surface as the bubble breaks.

On the matter of the effect of surface aeration, some unpublished work on pilot plant studies by J. A. McCarthy, Chief of the Lawrence Experiment Station, is of considerable interest. McCarthy operated two parallel activated sludge pilot plants; one aeration tank received air from a submerged diffusion system; the other obtained its oxygenation entirely from surface aeration induced by a revolving paddle reel in a trough just below the top of the tank and with the bottom of the trough connected by a slot to the bottom of the tank so that circulation of tank contents was obtained. McCarthy found that the BOD removals in the two tanks, operating on settled sewage for three years, was substantially the same (89 to 90 percent removal).

In another experiment, McCarthy operated three identical pilot plants, using air in one tank, high oxygen atmosphere in the second and pure nitrogen in the third. (Obviously, this third tank obtained all of its oxygen from surface aeration.) The BOD removal results from these three pilot plants were substantially identical at 88 to 89 percent; settled sewage was treated.

Although these data were obtained on pilot plant studies, they do indicate that effective aeration is obtained from the surface exposed to the atmosphere and that this aeration is appreciable when that surface is in a constant state of change. These observations tend to give added importance to this factor of surface aeration, more so, perhaps than has been thought true in the past, particularly with respect to spiral flow aeration tanks.

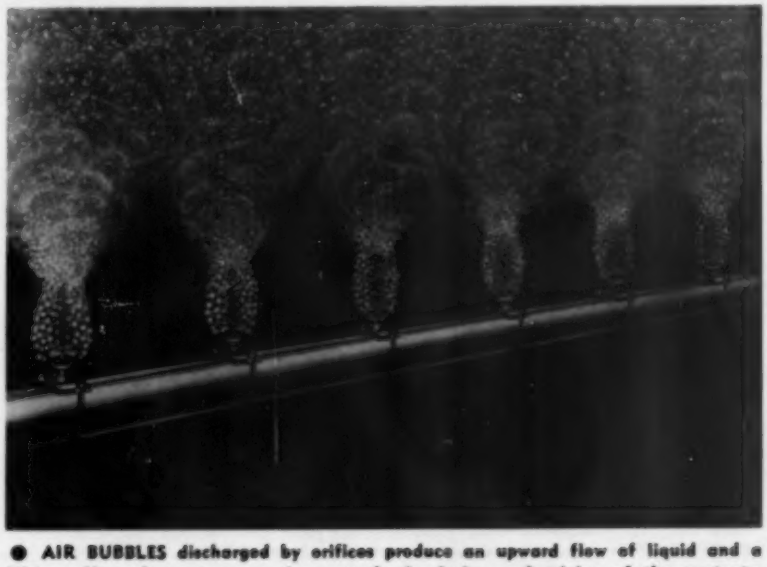
From consideration of the several factors noted here, it appears that in order to increase the rate of absorption, a special technique needs to be employed to create new gas-liquid interfaces and to increase the areas of these interfaces. In addition to decreasing the size of the bubble in order to increase interface area, turbulence or stirring offers the best means of obtaining the desired effect of increased rate of absorption.

Bubbles or air introduced at the bottom of an aeration tank serve to provide dissolved oxygen for the maintenance of biological activity. Such bubbles also furnish the turbulence and agitation necessary to keep the floc in suspension and to provide stirring to increase the rate of the four slow steps in the activated sludge process.

It is recognized that in bubble aeration, only a small percentage of the oxygen supplied to the system is actually absorbed by the liquid from the dispersed bubbles. Any means to increase the efficiency will result in reduction in operating costs. According to Kountz (4) to increase this efficiency, an air diffusion device should produce the maximum number of bubbles of minimum diameter and keep them separated until they reach the surface. This idea presupposes that there is a little effect due to turbulence created by controlled bubble rise or by bubbles breaking at the surface.

Development

Much of the past effort in this field has been directed toward diffusing air in the smallest bubbles practical over relatively wide areas of tank bottom, on the theory that this would give the best oxygen utilization, regardless of other considerations. To diffuse air in the amount used per foot of tank length in normal activated sludge practices over a relatively wide tank area requires the use of media with very small interstices. In most applications, such media is subject to varying degrees of clogging, with the resultant increase in power consumption and maintenance costs.



● **AIR BUBBLES discharged by orifices produce an upward flow of liquid and a lifting effect that causes maximum tank circulation and mixing of the contents.**

Also, this wide band arrangement of air diffusion decreases the tank circulation velocities (turbulence). Decreased turbulence is a condition that is detrimental to both optimum oxygenation and to the rate of biological oxidation by the floc, particularly in mixed liquors of high suspended solids content such as are encountered in many industrial waste treatment plants handling high BOD wastewaters.

Development work on air diffusion equipment should have one basic criterion, namely, the great importance of turbulence to good diffusion and to good oxygen utilization. In the work done under the author's

direction, efforts were directed toward a narrower, properly placed air dispersion area, which would result in greater tank circulation velocities. In this development work, a fundamental requirement was borne in mind, namely, that freedom from any diffuser clogging is one of the most important factors if long range power and maintenance costs are to be held down.

As indicated above, the gas absorption coefficient can be increased considerably through turbulence which results in more rapid replacement of the water film at the air-water interface and which also results in decreasing the film thickness. Thus it seemed logical that effort should be directed toward forming fresh film contact surfaces by enhancing turbulence. It was found that turbulence enhancement can best be done by aerator design and air band pattern.

In a narrow dispersion area, the turbulence in the rising mixture of air and water results in higher rates of film replacement. With the constant re-forming of smaller air bubbles from that portion of the air which momentarily coalesces in the concentrated turbulent air pattern, much of the air is worked into the higher initial transfer phase as bubbles form and re-form.

In aerator devices covering a considerable portion of the tank area, where all bubbles are essentially isolated as they rise to the top, there is limited film replacement, a condition which the writer's development work sought to overcome.

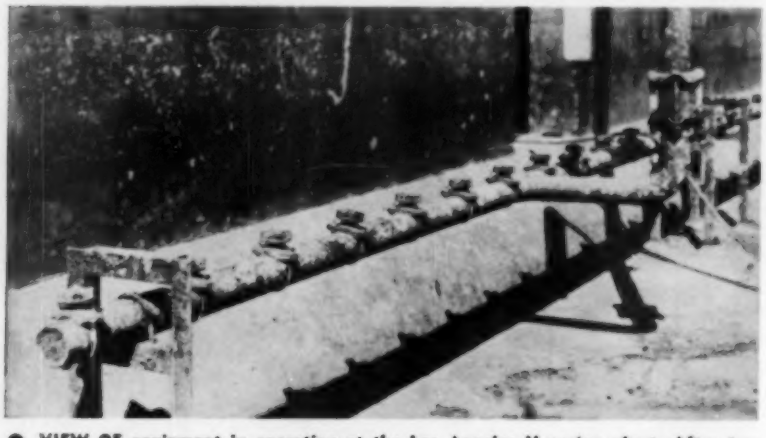
In narrow air dispersion bands, turbulence is of major importance in breaking down larger bubbles into smaller bubbles of stable size, and in preventing small bubbles coalescing into excessively large bubbles.

Higher tank circulation velocities increase surface aeration, which contributes considerably more to overall oxygen absorption in spiral flow tank design than has generally been believed, as pointed out above. Greater turbulence in narrow band dispersion creates greater surface aeration. Higher tank circulation velocities also result in carrying many fine bubbles of air throughout the tank, thereby increasing the time of contact of the bubble interface with the surrounding liquid. At lower tank circulation velocities, most of the air escapes to the atmosphere immediately, although some air bubbles are carried across the tank and held in a semi-fixed position by the descending water. These observations were made on a large test tank provided with view ports and underwater lights.

From consideration of the theory outlined and research studies carried out, the first type of narrow-band dispersing device was developed. It was the impingement aerator which was successfully field tested in many installations. From that development came the idea that through further controlled use of higher tank recirculation, a simpler dispersing device could be developed to have wide application in activated sludge and pre-aeration installations; a device that would still retain the basic requirement of freedom from mainter.ance and absence of any back pressure buildup.

The answer came with the development of accurately reamed short tube orifices ranging from ⅛ to ⅜ in. in diameter, and clustered in groups of four. The orifices were sized to yield an air velocity between 100 and 300 fps. The device was termed the Diffusair Sparjer. The large orifice size makes unnecessary any elaborate air filtering equipment. Also the high air release velocity insures two important factors: 1) Accurate division of air among the four orifices, and 2) the avoidance or prevention of any continuous counter current entry of slime bearing fluids into the orifice to cause clogging within.

In operation, each orifice cluster acts as an efficient air-lift device—the circulating liquid sweeping across the floor and joining with the slip-stream immediately above the sparger. The design of these orifice groups is important and determines just how efficient the air lift effect above each will be. The mixture of air bubbles and liquor comprising each air lift, streams rapidly upward for a short distance (12 to 18 inches) until, passing through a critical velocity, a sudden change in energy causes the bubbles to shear; that immediate region becomes charged with minute bubbles. The size of these newly formed bubbles averages as small as those discharged from No. 40 permeability media. The sparger groups act side by side in a row and effect a united front of air lifted and fine bubble oxygenated liquor.



● VIEW OF equipment in operation at the Los Angeles Hyperion plant. After two years of service the orifices were not clogged though they were coated with slime.

Bubble Size Control

The size of the air bubbles emitted by the diffuser is controlled somewhat by the jet velocity and orifice size, but the stable bubble size established after release is still governed by other physical laws. Larger bubbles tend to divide into smaller bubbles and small bubbles tend to coalesce, both approaching a critical size for any degree of local tank turbulence. Also, the greater the average turbulence, the more active and more numerous the active vortex zones become. Each time air bubbles enter these active vortex zones, bubbles are broken down into small stable bubble sizes, hence additional oxygen absorption is obtained from bubbles that would otherwise have acted inertly.

Simple nozzle or drilled pipe orifice diffusion should not be confused with the unique principle of the Sparjer device. Ordinary orifices for oxygenation will not work efficiently when they do not fulfill three necessary operating conditions: 1) The air must have a discharge velocity into an accelerating approach of liquor moving swiftly through the orifice groups; 2) the rising slip stream must pass through a critical velocity with a sudden change of energy further dividing and reforming small bubbles, and 3) the orifices

(*Continued on page* 182)

● DOUGLAS County Board of Commissioners, left to right, Chairman N. L. McLandress, and members Roy A. Nelson and Eugene Weimerskirch, get a first-hand look at County Road Department runoff problems.

HOW A COUNTY HIGHWAY ENGINEER HANDLES PUBLIC RELATIONS

A CONSTITUENT was complaining last night . . . Did you hear him? Or was your public relations so far removed, from the public that you have no contact? Herein lies one of your most important engineering administrative jobs — preventing the spread of bad publicity.

Good public relations is a preventive measure; any government agency having a temporary period of bad publicity without correcting the misconceptions, places its entire public relations program in jeopardy. A continuous frank explanation of the aims and policies of your organization is necessary to gain the public confidence.

Actually, public relations is many different things to the different people that you come into contact with. To some people, it means merely good service. To others, it means service with a smile and the extra embellishments that make them feel they are getting their money's worth. And to still others, it means keeping them fully informed on the present and future policies of the organization. If we were to consider public relations in its broadest sense, almost every act of each of your personnel is involved. The problem of the administrative engineer is to realize the persuasiveness of public relations and that his own every act is involved. Public relations is an organizational way of living; and if each county road organization will recognize that fact and start planning carefully, its public relations program will take effective shape and the public interest in its organization will be enhanced.

Community relations is not a mysterious process. An organization is simply a group of people engaged in some specialized activity — in your case road construction and maintenance. The people that you are trying to reach are actually your neighbors. Your road department can acquire a community personality, but this must be built from the top of the organization on down. Your community personality can be custom-made by a proper public relations program. But your organization must know the entire community in which you deal — its habits, weaknesses and desires of the people as a whole.

Selling a Program

Fundamentally, public relations is selling. As a road department, you have two things to sell: the service that you are giving your constituents, and your fiscal program and future needs. To be a good public relations salesman, you must first thoroughly know your product. It is impossible to sell a program of any type unless you yourself have developed an honest conviction of its advantages. Your facts have to be honest and accurate. In this day and age, there are too many well-informed people who can spot the phony facts a mile away. The public does not expect you personally to be acquainted with all the answers, but they do expect you to get the facts before you talk. This often means consulting outside experts before reaching final conclusions. And the public relations touch requires being pleasant in your contacts while developing the quiet ability to lead without public awareness of being led. In other words, public relations should be at a continuous low level pressure rather than in spurts of fanfare and trumpeting. Any capacity of an administrator to build a sound highway organization depends upon his ability to talk common sense, not only to his immediate help but to his constituents. An engineer does not have to be a second eloquent William Jennings Bryan. Nor does he need to be as grammatically correct as some col-

PAT THOMSON,
County Engineer,
Douglas County,
Waterville, Washington

lege language professor. Above all, what he says must show a basic relationship between him as the engineer, his work and his surroundings. His words must be presented adequately to bring about a complete understanding of his ideals, ideas and hoped-for accomplishments.

An engineer administrator must create an atmosphere out of his speaking and writing that invites his public to think and speak on a level with him. Engineers can no longer be silent. They must discover the value of the spoken and written word. This does not mean being overly solemn or grandiose. It means building a verbal bridge between you and the public — a bridge the public is more than willing to cross if properly invited. We must learn to put our program together so that we and the public can think together on common terms.

● **TIME, MONEY and plenty of engineering are necessary to insure a proper network of roads in an irrigated agricultural area. Full publicity regarding the work is important so that the public will be informed of the costs and problems involved.**

A public agency is more vulnerable than free enterprise. It is always the target for reformers and planning groups who want to socialize business. The charge is likely that the road department has not taken advantage of the latest technological developments for most efficient operations. Consequently, there are two basic factors in any public relations campaign. The people that you want to reach and the means that you use to reach them.

The people that you want to reach, of course, are your rural road users. But who are they? Are they all doctors, or lawyers, or housewives, or laborers? Obviously not, they come from all walks of life, from varied incomes, and all levels of cultural background. They are the general public, which doesn't actually exist at all. Each individual has a political view, a religious view, a working view, a social view, and a civic view; at separate times, he identifies himself with each of these "public" views. And though you can't contact him face to face, your publicity program should try to contact him through several of his various views. To do this, all medias of contact must be utilized.

Mass Media

There are thousands of publications with a specialized circulation in your state, area or locality. Their readership is high and their influence is strong. I cannot recommend how much effort, time or money you should put into these periodicals; but the field should be covered as thoroughly as possible. The administrator should keep a card file of all the pertinent periodicals in his area, giving the title, publisher, editor, address, circulation, publication deadline date and publication date. It is best, if possible, to get to know the editor personally. Before approaching him, review several issues of his publication so that you will be aware of his editorial slant and audience. The kind of acceptable material — filter, editorial, article — will depend upon the format and editorial policies. Make suggestions for special features, photos, and art work in a letter requesting the editor's cooperation. Then if he agrees, have the material in his hands on the date set by him. When used, write the editor a personal thank you note.

Newspapers must be handled differently. Newspapers want news not publicity material. They are interested in stories about events, people and places in the locality; and the news must be interesting to the readers. It will help if the news editor learns to trust you as a reliable source of news items. And two important items should be noted here: Do not release a story as exclusive — the same release should go to all the daily papers in your area. Competing dailies can cause you a great deal of trouble. Take the editor's advice in not releasing important stories on days when the paper is going to be slim in news space due to a big advertising promotion or big news break.

An omnivorous media can be the local radio and TV stations. Radio and TV people are busy, for every hour is rush hour. This I can vouch for, in having written, directed, and mc'd a television show weekly for two years. However, public service broadcasting is part of their job. Both radio and TV stations are individualistic, so that you should know the program director's name before calling, and be acquainted with his personalities and program. Call your program director early, let him set the appointment time at his convenience, and then be on time, for he literally lives by the clock. Make your presentation precise, give him your releases and get out of his way.

Personal Appearances

Last but not least, go to the individual type where presentation is made in person before the various civic groups, lodges, ladies organizations and other interested groups that want you. We have developed what is called a "gripe" night. These are nights in which we meet with our local groups, present a detailed slide show of our operations and answer any questions presented by the public. We want the questions to be searching, digging and prying into our business. And we will venture into any pertinent subject except two: party politics and individual personalities.

What makes a good slide show for your rural public? First, you must have enough pictures. And the preliminary editing actually begins in the camera. You must shoot the pictures that will interest your au-

● **WINTER is one of the tough times in a County Road Department. Full use should be made of pictorial opportunities for later use in a broad public relations program.**

dience, using the movie technique of long shots, medium shots, and closeups. But having plenty of slides is not enough. They must be arranged so that they tell a proper story of your operation Make use of a shooting script to get proper continuity into your slide show. No matter what type of show you are going to have—whether illustrating the construction of a road, the making of a budget or the engineering necessary for the design of a bridge—it must start somewhere, have a logical sequence and end somewhere. It should follow in the same continuity as it would if you were giving a speech without having the benefit of slides. Then by blending in the proper amount of commentary, even adding some appropriate background music, your propaganda slide story will provide an hour's entertainment for even the most critical public audience.

How long should each sequence be? When covering an interesting subject, use more than one picture of the subject from different angles. Each slide should be on the screen long enough for your rural audience to grasp the meaning of what it is intended to portray. Some ideas can be caught quickly, others take longer. However, if a slide is on too long, even though more commentary is needed, the audience becomes bored. With a variety of angles of the same subject you can cover your commentary with several slides and then have time to explain your point in words if needed.

Smooth transition shots are the necessity of a good slide show. One shouldn't jump from the discussion of a budget directly into a rock crushing sequence without some device to prepare the audience. When you go from place to place or idea to idea in your slide talk, take your audience with you through the use of transition slides. Don't leave them behind as you suddenly jump to a new scene.

Edit your slides. It is better to show a few good ones than bore your audience with a batch of bad ones. Your music can be by records and turned down when you wish to talk. Or you can put it on a tape recorder so that you have smoothness in your show. However, the music must be selected to fit the mood of your slides. Obviously, one would not have a light airy semi-operatic piece when heavy bulldozers are moving mountains of solid rock.

Everyone likes to be thanked. So if you will close your slide show with a warm thank you to the audience for giving you the opportunity to present your material and for listening so courteously, you will be welcomed with open arms the next time around.

The secret of good public relations lies in the formation of good contact habits. If we acquire a diversified, well-thought out set of public relation habits to take care of our daily actions, then we will not have to worry about our community relationship of tomorrow. Why don't you start to build your public relations habits now!

REFLECTORIZED PAVEMENT STRIPING AT MINIMUM COST

JOHN A. ANDERSON
Marion County Engineer,
Salem, Oregon

DESIRABLE features of reflectorized centerline striping have been obtained by the Marion County (Oregon) Road Department at very little increase in cost. This was accomplished by intermittent, rather than continuous reflectorization.

When reflectorized striping became an accepted feature on the State Highway system in Oregon, Marion County viewed the nighttime visibility of these lines with increasing envy. The effect of the beaded lines was far superior to unbeaded lines in all kinds of poor visibility—fog, rain and darkness. Yet, with our limited striping budget, we did not feel that we could afford to reduce our striping mileage sharply just to provide this added safety feature of nighttime reflectivity. Beaded paint or paint with beads applied throughout would almost double our costs, we felt.

In 1956, a local paint manufacturer, Norris Paint and Varnish Company, suggested that we experiment with centerline striping with only partial coverage with beads. This sounded as though it was worth investigating. Accordingly, our paint machine was equipped with an inexpensive Flexolite bead dispenser. Experiments were conducted with different types of bead coverage, and we decided that a short intermittent beaded section in each stripe was the cheapest method to use in order to produce a reasonably good reflective centerline stripe. We finally adopted a pattern of three intermittent 18-inch strips or "pips" of beads applied over our regular 15-foot stripe—followed by a 25-foot skip.

One trouble remained, however, and that was the inefficient hand method of applying these "pips." After some experimenting, our shop superintendent developed a simple mechanical device which automatically dropped beads intermittently for three 18-inch lengths on the fresh paint. The principle used was an eccentric cam operating the opening in the bottom of the bead dispenser.

The three "pips" of beads give the nighttime appearance of a solid reflectorized line at moderate speeds and within the effective range of

● **CLOSE-UP of the County two-gun striping machine, showing bead dispensing box. Pickup truck, which carries extra supply of paint, furnishes motive power for unit.**

the car's headlights. In addition, the centerline stripe looks brighter during the daylight hours than if it had been beaded its entire length.

During the summer of 1957, approximately one-half of the 482 miles of centerline striping was beaded with intermittent "pips." The average cost of the unbeaded lines was $19.71 per mile. The average cost of the beaded lines was $22.47 per mile—an increase of only 14 percent.

The following summer, 1958, we beaded all of our centerline mileage —some 492 miles. The average cost was $21.89 per mile (less than the previous year's operation) with the beads costing $2.18 per mile of this amount.

The reduction in cost of centerline stripe application in 1958 over 1957, even in view of some increase in labor and material costs, was due primarily to another important advance in Marion County's striping operation. Again we were helped by a suggestion from the Norris Paint and Varnish Company. Why not pump directly from 50-gallon drums of paint? We adopted this feature for our 1958 operations and found that converting to the use of 50-gallon drums was the big factor in cutting our costs and increasing production. In addition to the reduction in paint costs by using larger containers, down time for refilling was practically eliminated. Also we reduced our striping crew by one man.

Here is a brief description of our County striping operations: The striping machine, which is pushed down the road by a pickup truck, is equipped with two guns. One of the guns can lay down a solid no-passing stripe, while the other gun is laying down the skip stripe with the three "pips" of beads mentioned above. The solid gun is trigger operated, while the skip gun is operated by a cam mechanism powered by a fifth wheel. This wheel actuates the trigger on the gun and on the Flexolite bead dispenser. The bead dispenser is controlled by a cam operating an air actuated cylinder and is mounted on the striping machine. Paint is supplied to the Binks barrel pump by air from a compact, portable, gas-powered air compressor which is carried on the pickup. Extra barrels of paint for the operation are also carried on the pickup.

Behind the pickup, a cart is towed from which cones are placed to keep traffic off the fresh paint. This cart doubles as a transport for the paint machine between striping operations. The striping machine operator controls the direction of the machine by steerable front wheels and use of a sighting device on the striping machine itself. A third man rides on the small towed cart and places the cones, while the final member of the crew brings up the rear in a jeep, picking up the cones after the paint is dried sufficiently to permit traffic to cross.

During the current 1959 striping season, we have made further effort to improve our striping efficiency. We are now pre-heating the barrels of paint prior to each day's operation. This has resulted in more uniform temperature and viscosity of the paint and has eliminated the need for frequent nozzle adjustments. In addition it is producing a more uniformly finished stripe and our striping season can be extended.

During this past season we have striped a total of 524.6 miles of roads at an average cost of $23.41 per mile. This increase of $1.50 per mile over the 1958 costs was due entirely to the additional cost of materials and labor.

● **STRIPING train at work. First is the striping machine, shown above; then the pickup truck, with paint; and the cone cart.**

NEWS BULLETINS

AMERICAN PUBLIC WORKS ASSOCIATION, 1313 EAST 60th STREET, CHICAGO 37, ILLINOIS

1959 APWA Yearbook

The 1959 edition of the American Public Works Association Yearbook, the first to be published under this title, has been mailed to Association members. The Yearbook also contains several new features such as the annual report to the membership, the APWA Research Foundation's Progress Report for 1959, and the service record of past and present members of the Association's Board of Directors.

As in the past, the Yearbook also contains the proceedings of the annual Congress, an alphabetical and geographical listing of members, a listing of officers and committees, the constitution and rules governing local chapters, and a section devoted to professional announcements and commercial advertisements.

All papers presented at the Seattle Congress are reproduced in the Yearbook. These include talks and discussions by leading authorities in the public works field on a great diversity of topics. The Yearbook is available to non-members at $5.00 per copy.

Distinguished Service Awards Given at Los Angeles

Los Angeles, Calif.—Presentation of the Chapters' annual distinguished service awards highlighted the December 10th meeting of the Southern California group. Cited for their outstanding work were: Charles F. Briscoe, for outstanding work as Chairman of the Chapter's Membership Committee; Clayton W. Paige, for his outstanding work in the field of public works, in the administration and planning of many worthwhile projects; Wade E. Peebles, for his outstanding work as Chairman of the Chapter's Uniform Ordinances Committee, which recently concluded the preparation and publication of the Model Excavation Ordinance; and Warren A. Schneider, for his outstanding public works and engineering operations in directing the crash program in the City of Los Angeles to establish city-wide rubbish collection service.

The formal presentation was made by Milton Offner, Chairman of the Chapter's Awards Committee.

Following the Award ceremonies the annual election of officers was held. Jack Thompson was elected President and Clayton Paige and Charles Handy were elected First and Second Vice-President respectively. C. C. Westmoreland will continue as Secretary-Treasurer and members of the Executive Committee include C. D. Chase, H. Halldin, William Henderson, F. Lohman, C. Lortz, B. Laulhere, and T. Zapf.

90 Attend Utah's 40th Annual Surveying & Mapping Congress

Salt Lake City, Utah—The 4th annual Surveying and Mapping Congress was held in Salt Lake City, December 7 and 8, 1959. The meeting was sponsored by the Utah Chapter, APWA, and the Utah Section, American Congress on Surveying and Mapping in cooperation with the Civil Engineering Department of the University of Utah. The 90 Engineers attending the Conference enjoyed a program which included presentations on "Ground Measurements in the Missile Program," "A Look at Utah's Highway-Economic Situation," "Controversial Technical Problems in Land Surveying" and "Accuracy of Photogrammetry in Highway Planning and Design."

Chicago Chapter Tours Incinerator Plant

Chicago, Ill.—Good weather, an interesting program, and general enthusiasm brought out 143 APWA members and guests to the Chicago Metropolitan Chapter's Fall meeting held December 3rd in Chicago.

The principal attraction was an inspection tour of the Calumet Incinerator Plant, the largest plant of its kind in the United States. Following the morning tour a luncheon meeting was held with Chapter President Armon Lund presiding.

Theodore Eppig, Deputy Commissioner, Bureau of Sanitation, Chicago, told the luncheon group that from 25 to 35 percent of the refuse by weight and from 14 to 22 percent of the refuse by volume that comes into the plant goes out in the form of residue. In answer to a question on costs, he said that cost-per-ton is not a fair basis for comparison because of differences in wages and other factors. Commissioner Eppig explained that one of the two plants in Chicago operates at a little under $3.00 per ton and that the other

OFFICERS: Jean L. Vincenz, San Diego, Calif., *President*; Frederick W. Crane, Buffalo, N. Y., *Vice President*. REGIONAL DIRECTORS: (term ending 1960) Charles W. Cooke, Hartford, Conn.; R. S. Hopson, Richmond, Va.; H. H. Hester, Fort Worth, Texas; (term ending 1961) Louis H. Moehr, Wyandotte, Mich.; John A. Morin, Oakland, Calif.; W. A. Bowes, Portland, Ore.; (term ending 1962) Paul R. Screvane, New York, N. Y.; Albert G. Wyler, New Orleans, La.; Edward J. Booth, Bismarck, N. D. *Immediate Past President*, Wm. D. Hurst, Winnipeg, Manitoba. Robert D. Bugher, *Exec. Director*.

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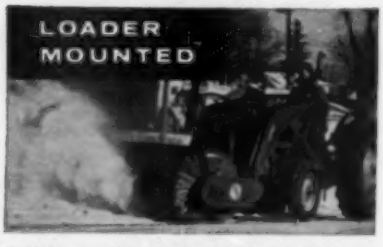
Two-way, angling sweepers with powerful hydraulic drive, swing and lift, speed up sweeping jobs. Exclusive centered sweeping path. Low cost, fixed angle sweepers with mechanical drive also available. 5 ft. and 6 ft. brush lengths.



Quick, on-the-job mounting, two-way type . . . interchangeable with bucket of any tractor loader. Independent hydraulic system with pump remains completely assembled on or off tractor.

For the big jobs, 7 ft. or 8 ft. two-way, pull type sweepers. Engine swings with brush providing simplified, rugged drive. Traction drive type available . . . also sprinkler or blower.

operates at a little over $3.00 per ton. He said that volume works in the plants' favor and that the figure is as low as it is, partially due to the tremendous quantity of refuse handled and partially due to the efficiency of the plants.

Transportation is Subject at New Orleans Meetings

New Orleans, La.—A transportation study for Metropolitan New Orleans was one of the major topics discussed at meetings of the New Orleans Chapter held during November and December. These were two of a series of five presentations on the subject planned by the Chapter's Program Committee for the 1959-1960 year.

At the November session, Charles O'Doniel, Jr., Assistant Director of Planning of the New Orleans Planning Commission, stressed the need for a transportation study for the city and suggested that the local chapter undertake the collection of basic data and the preparation of a prospectus from which a transportation plan could be evolved. The question was referred to the executive committee.

Subsequently, at the December meeting, a special committee was appointed to investigate the scope, purpose and possibility of initiating such a study at the local chapter level.

Albert Wyler, Director of Streets of New Orleans and Regional Director of APWA, presented a report of the November meeting on the Public Works Congress held in Seattle. S. diBenedetto, Civil Engineer, New Orleans Sewerage and Water Board, said the APWA members participating in the Forum on Water and Sewage at the Congress were interested in the methods used by New Orleans in disposing of rainfall, and many, he said, expressed a desire to tour the city when they come to the 1962 Congress at New Orleans.

Highlights of Western Pennsylvania Meeting

Pittsburgh, Pa.—A full day's activity was planned for the more than fifty members and officials attending the Fall meeting of the Western Pennsylvania Chapter of APWA. Held on the campus of the University of Pittsburgh, the morning session was devoted to a discussion of "de-icing" municipal streets and human relations and the public works supervisor. During the afternoon, Chapter members and guests visited the asphalt plant of the Pav-All Corporation and concrete pipe manufacturing plant of the American-Marietta Company. A social hour was held after the field trip.

The "de-icing" panel featured talks on the use and application of sodium and calcium chloride in street snow and ice control programs, the place of salt corrosion inhibitors in such operations and the effects of chlorides on concrete streets. Participating were: A. R. Armstrong, International Salt Company; Robert Moody, Columbia Southern Chemical Company; William C. Peternel, Township of Mt. Lebanon; and G. W. Schweitzer, Calgon Company.

In his talk on human relations, Dr. Harry W. Karn, Professor of Psychology, Carnegie Institute of Technology, discussed employee needs and how conflicts of these needs affect a worker's performance. Dr. Karn also stressed the role to be played by public works supervisors in motivating employees and in combating their frustrations.

At the conclusion of the morning session, a business-luncheon meeting was held at the University Club.

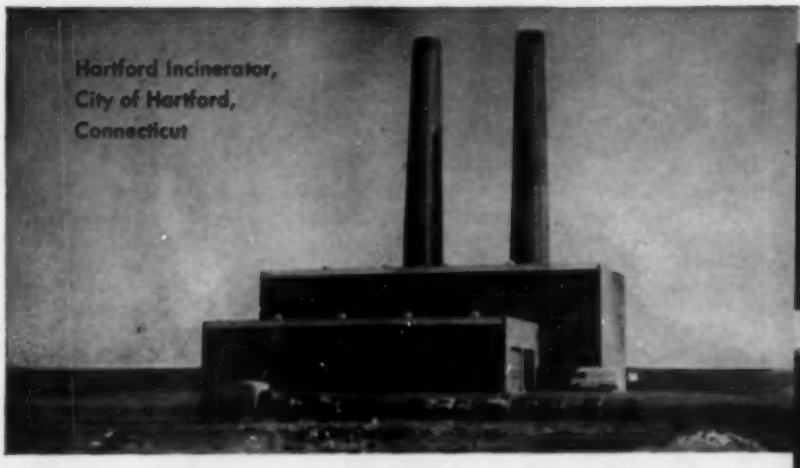
The next chapter meeting is scheduled for Friday, February 19, 1960.

150 Attend Tenth Annual No. California Meeting

Oakland, Calif.—The tenth annual meeting of the Northern California Chapter was held in November at Oakland, with 150 in attendance.

Speaking at the opening session, Robert D. Bradford, Director of Public Works for the State of California discussed administration and management in public works. Future traffic conditions and the water problem in California were two of the major issues which Bradford touched upon in his talk.

At an afternoon symposium on Administration and Management Harry Rosenberg, Assistant to the City Manager, Oakland, Calif., spoke on cost and revenue problems of management. Regarding the recruiting of professional engineers, Rosenberg stated that the problem would become more difficult to solve in the future because (1) Cities must continue to compete with industry wagewise for engineers, and (2) professional engineers will insist upon preserving and improving their professional status. Joseph P. Sinclair, Assistant Highway Engineer, Division of Highways, District IV, San Francisco, told chapter members that an engineer as a manager must realize that he will be com-



(1) Hartford's Fitchburg Chipper

(2) Fitchburg Chipper in action

Modern Hartford disposal plant uses FITCHBURG CHIPPER

Hartford's new municipal incinerator is used to dispose of more than 400,000 pounds of waste every day. The large picture above shows this efficient, attractive plant—one of the most modern in the nation.

An important part of Hartford's up-to-date disposal program is their portable Fitchburg Chipper, which cleans up disposal jobs the incinerator cannot handle, and goes out on location for road use.

Hartford had these problems:

- *Banana Stalk Disposal*
- *Brush Disposal on New Roads*
- *Christmas Tree Disposal*
- *Road Clearance from Storm Damage*

How a Fitchburg Chipper solves these problems:

Joseph J. Coffey, Superintendent of the Hartford Incinerator, tells you in his own words how Hartford solves these problems: BANANA STALKS: "We chip 2 to 4 tons of banana stalks each week. These stalks will not burn regardless of heat in the furnaces, and we had to dump them until the Fitchburg Chipper went on duty." CHRISTMAS TREES: "During the post-Christmas season we receive many Christmas trees which we can now get rid of without the trouble of watching for burnt-down spike-like stubs which cause much trouble with the incinerator equipment."

BRUSH DISPOSAL: "Our Highway Division has used our Fitchburg Chipper to clean up the brush and branches along newly developed road areas. By chipping brush, the city saves in use of both manpower and trucking costs." ROAD CLEARANCE: "If we get hit again by hurricanes or bad wind storms, we now have an excellent piece of equipment that will enable us to readily open up the streets for emergency traffic by reducing the fallen branches to chips."

As to maintenance, Mr. Coffey says: "Our Fitchburg Chipper will pay for itself in a very short time. Maintenance, so far, is just keeping it supplied with gasoline and fully lubricated. It is easy to handle, easy to store, and very easy to use."

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LINE CLEARANCE

The Shade Tree Service Company, Webster Groves, Mo.: "Our figures show that production has been increased by a good 25% with the use of the Fitchburg Chipper. One man can operate the chipper with ease. He alone can handle as much, and more, brush in the same length of time as could two men loading brush on a platform body."

POWER COMPANY

Rockland Light and Power Company, Nyack, N. Y.: "Our men have been particularly pleased with their Fitchburg Chippers. They are rugged and reliable and the convenience of flexible, yet instant brush disposal has the advantage of promoting good public relations and still gives us efficiency."

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pelled to lay aside his scale and slide rule. He stated that all technical engineers who reach the management level should equip themselves with administrative training. Frederick C. Mosher, Professor of Political Science, University of California, Berkeley, spoke on "The Budget and Public Responsibility." James L. Martin, Assistant City Engineer, San Leandro, acted as moderator.

The final afternoon symposium covered the subject of "General Engineering." The moderator was Laurence W. Milnes, Public Works Director, City of Fremont, California. Captain C. B. McMurphy, Chief Communications Division, Sheriff's Office, Alameda County, spoke on "Radio Communications." Dennis R. Campbell, Reproduction Supervisor, Division of Highways, District IV, San Francisco, spoke on "Saving Engineering Time Through the Reproduction Processes," and Les Wanee, Assistant Construction Engineer, Division of Highways, State of California discussed "Major Changes in the Division of Highways' 1960 Specifications."

Manitoba Elects Officers

Manitoba, Can.—A. B. Moffatt, Consulting Engineer, Haddin, Davis and Brown, Ltd., Winnipeg, has been elected President of the Manitoba Chapter, it was announced at the Chapter's annual meeting in Winnipeg, November 13. S. R. Channing, Superintendent of Shops, City Engineer's Office, Winnipeg, was elected Vice-President and N. W. Diakiw, Superintendent of Construction, Winnipeg, was re-elected Secretary-Treasurer.

Elected to the Executive Committee were C. H. Templeton, C. Cunningham, T. H. Cousins, and H. W. Neilson.

Kentucky Chapter Holds Annual Meeting

Frankfort, Ky.—Nearly fifty members and guests turned out for the 1959 annual meeting of the Kentucky Chapter of the APWA at Frankfort on Thursday, December 10. The Honorable John Gerard, Mayor of the host city, opened the meeting by welcoming the delegates to the capital city and by pointing out that public works officials are the unsung heroes of local government in this country and should receive a great deal more credit and recognition.

Robert Davis, Superintendent of Public Works of Covington, presided at the morning session. Thomas Deen, Coordinator of the Urban Transportation Survey of Nashville, Tenn., explained how that city is utilizing the procedural manuals developed by the National Committee on Urban Transportation. "Financing Municipal Facilities and Services" was discussed by C. W. Grafton, an attorney from Louisville, Ky.

Chapter President Russell Marshall, City Manager of Frankfort, presided at the luncheon meeting program which included remarks by District Representative John Leake, Director of Louisville's Department of Sanitation, and APWA Executive Director Robert D. Bugher. Frank P. Lederer, Vice President of Cardinal Carryor Company, Inc., of Louisville, was elected President to succeed Russell Marshall. Herman Regan, Superintendent of Sewage Treatment of Lexington, was elected Vice-President; and Earl Patton, Director of Public Works and City Engineer of Owensboro, was elected Secretary-Treasurer.

The afternoon session featured an interesting panel discussion on "Coordination of Public Works" which was moderated by Earl Patton. Participating in the discussion were: Wallace Sanders, Director of Public Works and Wilbert Watkins, Traffic Engineer, both of Louisville; A. D. Langford, Chief Transmission Engineer, Kentucky Utilities Company, Lexington, and Jack Gibbs and Robert E. Bagby, Chief Right-of-Way and Special Assignment Engineer, respectively, of the Kentucky Highway Department.

Beenfeldt Named President of San Diego-Imperial Chapter

San Diego, Calif.—Jean L. Vincenz, Director of Public Works, San Diego County, and President of the national Association, spoke at the October 8 meeting of the San Diego-Imperial Chapter. Vincenz gave a report on the 1959 Seattle Congress, saying that the quality of papers, the enthusiasm of members attending, and the exhibits, were all outstanding.

An election of officers was held at the business meeting. Norman Beenfeldt, Division Engineer, California Water and Telephone Co., Chula Vista, was elected President; R. S. Hoke, Sales Engineer, American Bitumuls and Asphalt Co., San Diego, was elected First Vice-President, and E. F. Gabrielson, City Engineer, San Diego, Second Vice-President. Virgil L. Larson, Right of Way Supervisor, Pacific Telephone and Telegraph Co., San Diego, was elected Secretary-Treasurer.

62 gross engine h.p. with 1-yd. loader

Take the controls of a new Oliver Trans-O-Matic OC-96 Loader —and "let the tractor do the talking!"

Power shifting plus power steering (with three types of turns) makes the startling difference! The OC-96 is *so easy* to operate, it simply cannot be compared with older designs on this count—*or any other!*

You sit in a spacious, foam-rubber seat (offset for ideal visibility)...have full-freedom leg room in the wide, flush-deck compartment.

As for the controls, they're practically "in your lap." Levers for *power* steering, *power* reverse and *power* shift are placed directly ahead of the seat. Your arms are in "resting" position all the time. To brake or foot-steer, pedals do the job just as effortlessly.

Easy operation, indeed! The *easiest* you ever had—plus.

NEW! 3 types of power turns—The only crawler its size giving you counter-rotation turns for about-faces in the tractor's own length—also spot turns and gradual turns.

NEW! Power shifting—Shift from forward to reverse instantly, on the go. No clutching, no gear-clashing with Oliver's all-hydraulic Trans-O-Matic transmission. Four speeds in high or low range—forward to 6.05 m.p.h., backward to 8.07 m.p.h.

NEW! Torque converter—The OC-96 has heaviest-duty torque converter (not automotive kind)—delivering full engine power for digging and crowding in fastest non-stalling operation. Advanced 62 gross h.p. diesel.

NEW 1-yd. loader design—See how the OC-96 is an *integral* tractor-loader minus high, hung-on parts and cross members. Loader side pedestals are actually part of the tractor for low profile, high stability, finest visibility and safety. Fast breakout, greatest dumping reach. No other its size has such rapid work cycle—is so rapid-reversing.

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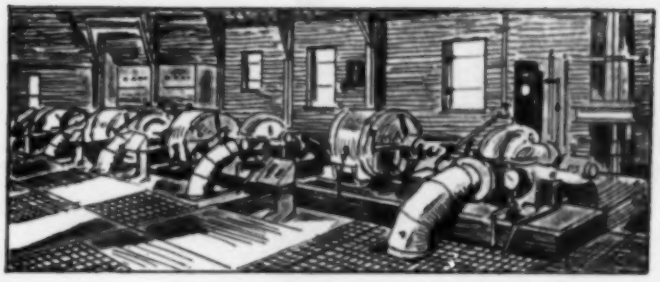
"Easy operation? Man, this OC-96 is the easiest I've ever seen!" "There has never been a crawler-loader like it for speedy, easy handling," says Lee Bruce of L. H. Bruce and Son, Middleton, Wisconsin.

On this big grading and loading assignment for a University of Wisconsin 2½-million-dollar student housing project, the OC-96 hustled the entire job. Six-yard trucks were put on a 2½-minute loading cycle. Counter-rotation turns cut time and working distance, permitted trucks to be spotted closer.

NEW CATALOG—"must" reading for cost- and comfort-conscious tractor users.

THE WATER WORKS DIGEST



Prepared by **ALVIN R. JACOBSON, Ph. D.**

Associate Professor and Head, Division of Sanitary Science, Columbia University School of Public Health

The New Look in Elevated Tanks

Within the past twenty-five years a great change has taken place in the design of elevated tanks. With the extension of distribution mains from the crowded downtown areas into the suburban areas to maintain adequate pressures it became necessary to give considerable thought to the design of elevated tanks from the standpoint of aesthetics. Aside from disliking the presence of naked steel columns and unsightly footings in the backyard, many homeowners were fearful of devaluation of their property. With the development of welded seams in tank fabrication, replacing the use of riveted seams, a new concept of beauty and utility in elevated tank design was born. There are five basic designs of steel elevated tanks: Double ellipsoidal, obloidal, toro-segmental bottom, radial cone bottom and the spheroid to choose from. With the exception of a slightly different volume of water within a given head range, and greater capacity available in some, the guiding factor in the selection is the desire of the owner. The author also discusses some aspects of the purpose, size and location of elevated storage tanks.

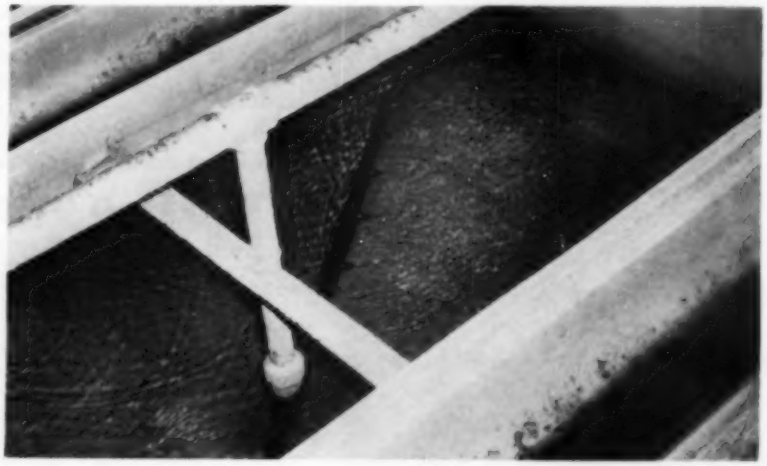
"The New Look in Elevated Water Tanks." By Robert L. Lawrence, Superintendent, Water Department, Alexandria, Louisiana. PUBLIC WORKS, January, 1960.

Water For Making Hardboard

It may come as a surprise to the uninformed that the principal ingredient, by volume, in the manufacture of wood pulp products, is water. This fact was of primary consideration in the design of the new hardboard mill erected by the Abitibi Corporation at Alpena, Mich. In addition, large volumes of steam are required at various stages of the manufacturing process, with extensive swings in demand which, individually, are large and sudden. These problems were successfully met at this plant which is located on Thunder Bay River, which provides the source of the water. The raw boiler make-up water is treated by hot-process softening, pressure filtration and zeolite softening. The boiler feed system includes a tray-type deaerating heater, two full-capacity boiler feed pumps and an automatic-feed water regulator at

FILTER BED AGITATOR Designed to Get the Corners

THE PROBLEM of making a rotating element effective in all portions of a rectilinear structure is common in water treatment plant equipment design. The Palmer Filter Equipment Co. has a unit designed to reach the corners and to span voids among multiple units operating in the same filter. Previous models of the Palmer agitator depended upon a jet-mounted straight arm revolving in a plane parallel to the filter surface. The arm ends were equipped with multiple jets to help provide agitation in the corners. The new unit has ends that curve in opposite directions to give the arm an "S" configuration. Nozzles are attached to both leading and trailing ends. Another feature of the new S-type Model 58 is that the nozzles on the straight portion of the arm are set both downward from the horizontal plane of the arm and outward from the center. The compoundly angled nozzles tend to produce cross currents promoting interchange of expanded filter media from one side of the bed to the other. Plans are underway to make available a field conversion kit to adapt the central portion of the arm of an existing older unit to have many of these advantages.



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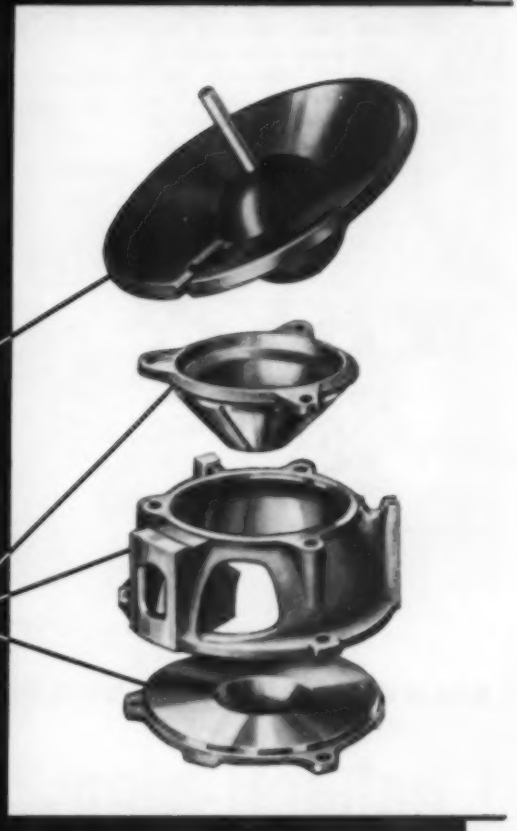

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Every engineer knows a cone shape is inherently stronger than a flat shape. Because of this designed-in extra strength, the Hersey Conical Disc Piston requires lighter reinforcing thus increasing its sensitivity and accuracy.

In addition, the conical disc's center of gravity is slightly above center of the ball, resulting in still further sensitivity over that of a flat shape.

The conical disc also makes possible a 3-piece measuring chamber. Only the relatively inexpensive top or bottom plate will ever need replacing. The more expensive chamber ring will never require repairs.

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each boiler. Mill condensate returns, as well as turbine condensate, are pumped to the deaerator. The highly fluctuating and sudden high-volume demands that are made on the system required some specialized design features on the otherwise standard conventional water conditioning processes. The unit is capable of operating at loads of 125 percent of basic rated capacity for periods not in excess of 60 minutes, occurring no more frequently than once each 120 minutes. Also it is capable of sustained operation at 150 percent of rated capacity for periods in excess of 15 minutes, occurring no more frequently than once each hour. Further details concerning the anthracite filters and Amberlite and anthracite softeners, as well as the deaerator are given in this article.

"Water For Making Hardboard." By A. G. Zeigler, Vice President & General Manager, American Water Softener Co., Inc. *Water Works Engineering*, December, 1959.

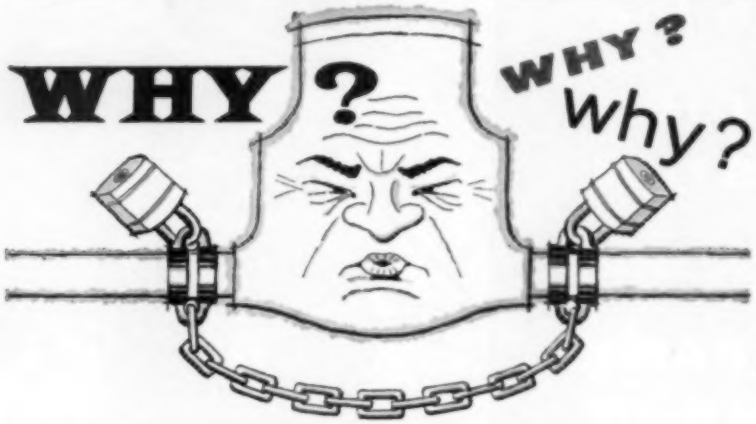
Distribution Storage

The spreading out of industrial, commercial and residential properties, improved transportation, and many other factors have caused a gigantic increase in the cost of new supply mains. At the same time, new uses of water, most of which are seasonal, have greatly increased the necessity for added facilities to maintain water pressure. When distribution storage was first used, the choice of type was limited to standpipes or elevated tanks. Ground level storage usually requires pumping when water is being drawn from storage. Early pumping facilities were expensive to construct, maintain, and operate. Central-station electric power, standby power, centrifugal pumps and automatic controls were either unavailable or unreliable. Today these limitations no longer exist. The fact that the height of the elevated tank fixes pressure so that it cannot be changed, no matter how necessary a change may be, is a disadvantage of elevated storage. Ground level storage, on the other hand, permits complete flexibility in maintained pressures, because they can be regulated as closely as desired. Greater flexibility in the selection of the tank location within the storage zone and the much greater choice in the size, design and materials used generally result in a lower first cost. The maintenance of elevated storage tanks is more expensive; cathodic protection also costs about twice as much for an elevated steel tank as for the same size of ground tank. The author concludes that ground level storage with the modern reliable, automatically-operated pumps is often preferable to elevated storage.

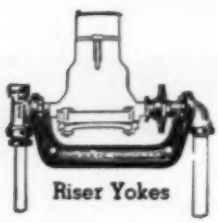
"Advantages of Ground Level Distribution Storage." By Marsden C. Smith, Chief Water Engr. (retired), Dept. of Public Utilities, Richmond, Va. *Journal A.W.W.A.*, December, 1959.

Feeding Glassy Phosphates

In this paper the author presents a brief review of how glassy phosphates are manufactured, their uses, and how they are fed into the water system. Glassy phosphates are produced by fusing a good grade of phosphoric acid with soda ash at high temperatures to produce a clear, transparent non-crystalline solid with a bulk density of 100 to 120 pounds per cubic foot. These phosphates are sold as broken glass, beads or in the granular or powdered form. They are added to water supplies to prevent problems of red water, scale formation and corrosion. Red water is caused by the



SHACKLE YOUR WATER METERS?


Riser Yokes

Angle Yokes

Straight Line Yokes

Ordinary old-fashioned meter couplings are frequently like shackles on your water meters. They often make meter changing so difficult and troublesome that periodic testing is omitted and proper meter maintenance neglected.

Be sure to set your meters the modern way. See that Ford Yokes are keeping every meter available for fast, fast, FAST changing and testing. Savings in time and increases in revenues can be really substantial.

You can change a meter in a Ford Yoke **EASILY**

There are models for every condition. Send for free catalog.

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THE FORD METER BOX COMPANY, INC. Wabash, Indiana

New John Deere 440 Crawler does more work "Single-Handed"!

The John Deere Crawler with Pilot Touch gives you an extra hand to *work* with, because *one* hand on *one* lever does all the driving—steer, stop, go, and reverse. The operator can give full attention to loader, winch, blade, or scarifier—producing more, and doing a better job in the bargain. Less effort is required—practically all clutch and brake footwork is eliminated.

Pilot-Touch control is an optional feature provided on both Diesel and gasoline "440" Crawlers. Any unit in the full line of John Deere Industrial Equipment is available on terms of the John Deere Credit Plan. See your dealer or write for the detailed information you need.

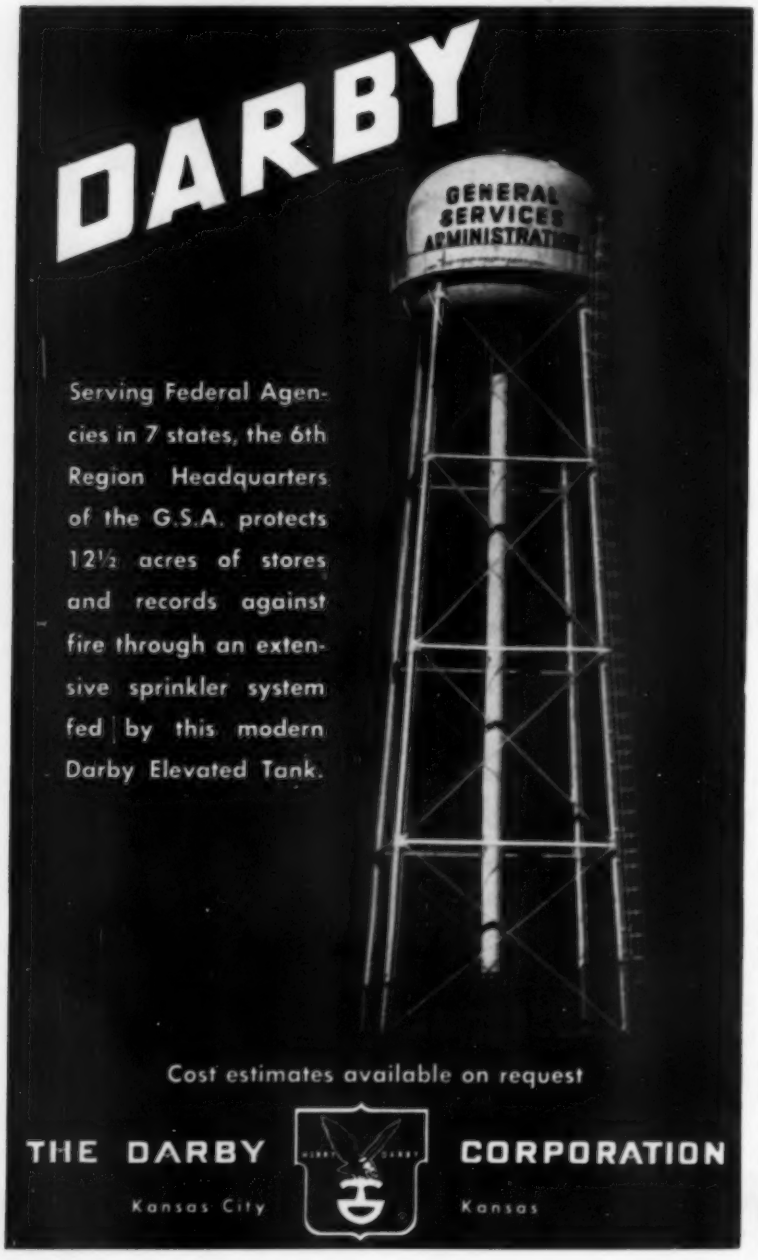
John Deere Industrial Division • Dept. 2506, Moline, Illinois

Drive crawler with left hand—control loader bucket with right—cut cycle time!

JOHN DEERE "*Specialists in Low-Cost Power with a Heavyweight Punch*"

presence of a high concentration of soluble ferrous or divalent iron having become oxidized to the insoluble ferric or trivalent state. The two common sources of this iron are either from the raw water or from the corrosion of the transmission pipes. Both of these conditions may be retarded and even entirely eliminated by the addition of the phosphate as a sequestering agent before the oxidation of the iron to the ferric state takes place. Scale in pipes or boilers is caused by the water becoming supersaturated with calcium or magnesium ions, resulting in precipitation as calcium or magnesium carbonate. This scale formation is prevented by the so-called threshold treatment in which the phosphate actually removes the crystal nuclei from solution thereby preventing crystal formation and growth. Corrosion, defined as the loss of metal into solution, is caused by galvanic action. Certain changes in conditions occur along the length of the pipe causing the formation of anodes and cathodes in the pipe. Electrons flow from the anode to the cathode causing the iron at the anode to be oxidized and go into solution. At the same time, the electrons at the cathode reduce hydrogen ions in the water to atomic hydrogen which combines with the dissolved oxygen in the water to form water. Addition of the glassy phosphates causes the formation of a complex between the phosphates and the calcium corrosion products which plates out on the cathodic areas thereby preventing the oxidation of the hydrogen ions. In most cases, the application of 2 mg/L of the phosphate is sufficient to prevent corrosion while 1 to 2 mg/L is sufficient against scale formation. For the prevention of red water problems, usually an amount of phosphates equal to 3 to 4 times the concentration of the dissolved iron is sufficient.

"Feeding Glassy Phosphates." By Henry F. Munroe, Sanitary Engineer, BIF Industries, Providence, R. I. *Water & Sewage Works*, December, 1959.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Big Water Plant—Small Plant Site

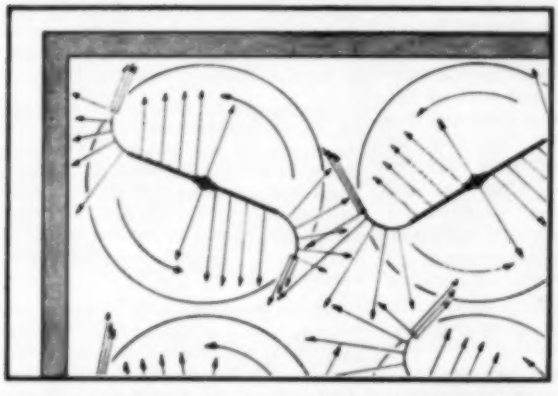
By next spring Salt Lake City will have completed its new 100 mgd water treatment plant costing approximately $7.5 million. Although large in capacity, the plant occupies relatively little space because of its modular construction. It includes facilities to handle a wide range of chemicals and is equipped to provide aeration, coagulation, sedimentation, filtration and disinfection. The ten mixing, coagulation and sedimentation basins are set in one row, with the grit collectors and aeration chambers on one end and all the filters on the other end. Raw water comes from two sources: The Deer Creek Supply, the major source, which flows from a large dam and storage reservoir about 55 miles southeast of the city and is delivered to the plant via a 42-mile, 69-inch concrete aqueduct; and the Little Cottonwood Creek Supply located just above the plant. The water is being brought into a junction box ahead of the grit removal and aeration channels by cutting into the two existing raw-water transmission mains located ahead of the plant. The water then flows from the aeration channels into two pre-mixing tanks, then into ten flash-mixing basins provided with Lightnin mixers. From the pre-mixing basins the water flows into the coagulation and sedimentation basins which are actually one tank, separated by brick baffle walls. Each coagulation basin contains six rows of paddles, with four paddles in each row, and is provided with the standard straight-line type of sludge

NOW... a 25% to 30% further increase in filter cleaning efficiency

Actual field tests show the new S-Type unit gives a 25 to 30% further increase in filter cleaning efficiency, with resultant increase in over-all plant efficiency. The old straight arm type of Agitator increased filter production beyond filter design. And now just a moment's study of the sketch below will show how much better this newly-designed S-Type will perform.

With it each of the corner and void areas will now receive **two** agitating impulses instead of one with the old style straight arm, thereby doubling the cleaning action in these areas. See drawing below.

New S-Type Filter Arms double the cleaning action.



COMPLETE COVERAGE OF ENTIRE FILTER AREA

See how the jets on the forward and following curved portions of the rotating arms give complete coverage of the entire filter area. Nozzles are now also angled downward and outward from the center to create a positive recirculation of expanded media throughout the entire filter bed. As a result no portion of the filter media is excluded from thorough cleaning action.

Portion of an S-Type Filter Arm in actual service.

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APCO

collector. The 20 filters are all in one row, butting against the effluent end of the sedimentation basins. All operations dealing with chemicals are concentrated in the chemical building. Financing is by means of an $8-million general obligation bond issue.

"Big Water Plant — Small Plant Site." By W. C. Hague, Chief Engineer, Metropolitan Water District, Salt Lake City, Utah. *The American City*, December, 1959.

Water System For Asuncion

For the first time in their 424-year history, residents of Asuncion, Paraguay, are enjoying the security and convenience of purified water pumped through their own municipal system. This water system was financed through loans totalling $9 million procured from the Export-Import Bank and from the Development Loan Fund on the basis of a study and feasibility report made by Rader and Associates, consulting engineers of Miami, Fla. This firm was then retained to design and write specifications for the complete system to serve some 250,000 inhabitants of Asuncion. The water treatment plant has a capacity of 56,000 cubic meters per day and consists of rapid mix, coagulation and settling, and rapid sand filtration. A clear well reservoir, main pumping station, plus supplementary reservoirs and pumping stations for varying levels of the city, are included in the system. The contract with Rader and Associates required the firm to furnish a resident engineer who supervised construction for the corporation (Corposana) established by the government of Paraguay to take charge of building and operating the water system. In addition, the consulting engineering firm was required to furnish a supervisor of operation for the two-year period following completion and testing. Training of local personnel is another requirement of the contract. Full scale service to 6,000 of an eventual 20,000 individual connections began last summer. The new supply of safe and palatable water is expected to give a tremendous boost to the development of Asuncion.

"A Modern Water System for Asuncion." PUBLIC WORKS, January, 1960.

Other Articles

'Survey on Compensation of Water Utility Managers." A report of Committee 4230 M—Compensation of Water Utility Personnel, with recommendations. By Garvin H. Dyer (Chairman), Vice Pres. & Chief Engr., Independence Div., Missouri Water Co., Independence, Mo. Other members of the Committee are W. R. Gelston, H. J. Graeser, J. C. Luthin, and R. A. Thompson, Jr. Journal A.W.W.A., December, 1959.

Need for **Demand Meters."** A panel discussion presented on July 16, 1959, at the Annual A.W.W.A. Conference, San Francisco, Calif. George H. Dunn, Exec. Vice-Pres., Philadelphia Suburban Water Co., Bryn Mawr, Pa.; Melvin P. Hatcher, Brown & Caldwell, Civ. & Chem. Engrs., San Francisco, Calif.; Roy A. Wehe, Con. Engr., San Francisco, Calif.; W. Victor Weir, Pres., St. Louis County Water Co., St. Louis, Mo. (deceased); Marvin E. Hartz, Div. of Res. & Eng., Badger Meter Mfg. Co., Milwaukee, Wis.; and Winthrop P. Hersey, Pres., Hersey Mfg. Co., Dedham, Mass. Journal A.W.W.A., December, 1959.

Reclaiming the Los Angeles River." Chemical coagulation of colloidal matter in stream flow permits city to divert formerly wasted water to spreading basins without clogging the seepage area. By Normal M. Imbertson, Engineer in Charge, Water Plant Operating Division. Department of Water and Power, City of Los Angeles, Calif. Water Works Engineering, December, 1959.

Explosive Growth of a District." How the situation has developed, and how the North Washington Street Water & Sanitation District has handled the problem. By V. A. Vaseen, Pres., Ripple & Howe, Inc., Denver, Colo. Water & Sewage Works, December, 1959.

Stabilization of Magnesium Hydroxide in the **Solids-Contact** Process." A discussion of the factors influencing this process. By Thurston E. Larson, Head Chemist; Russell W. Lane, Chemist; and Chester H. Neff, Ass't. Chemist, all of the State Water Survey Div., Urbana, Ill. Journal A.W.W.A., December, 1959.

"Flow Resistance in Pipes and Fittings." A review of the general problem of flow resistance in pipes and fittings. By Donald R. F. Harleman, Assoc. Prof. of Hydraulics, Massachusetts Institute of Technology, Cambridge, Mass. Water & Sewage Works. November, 1959.

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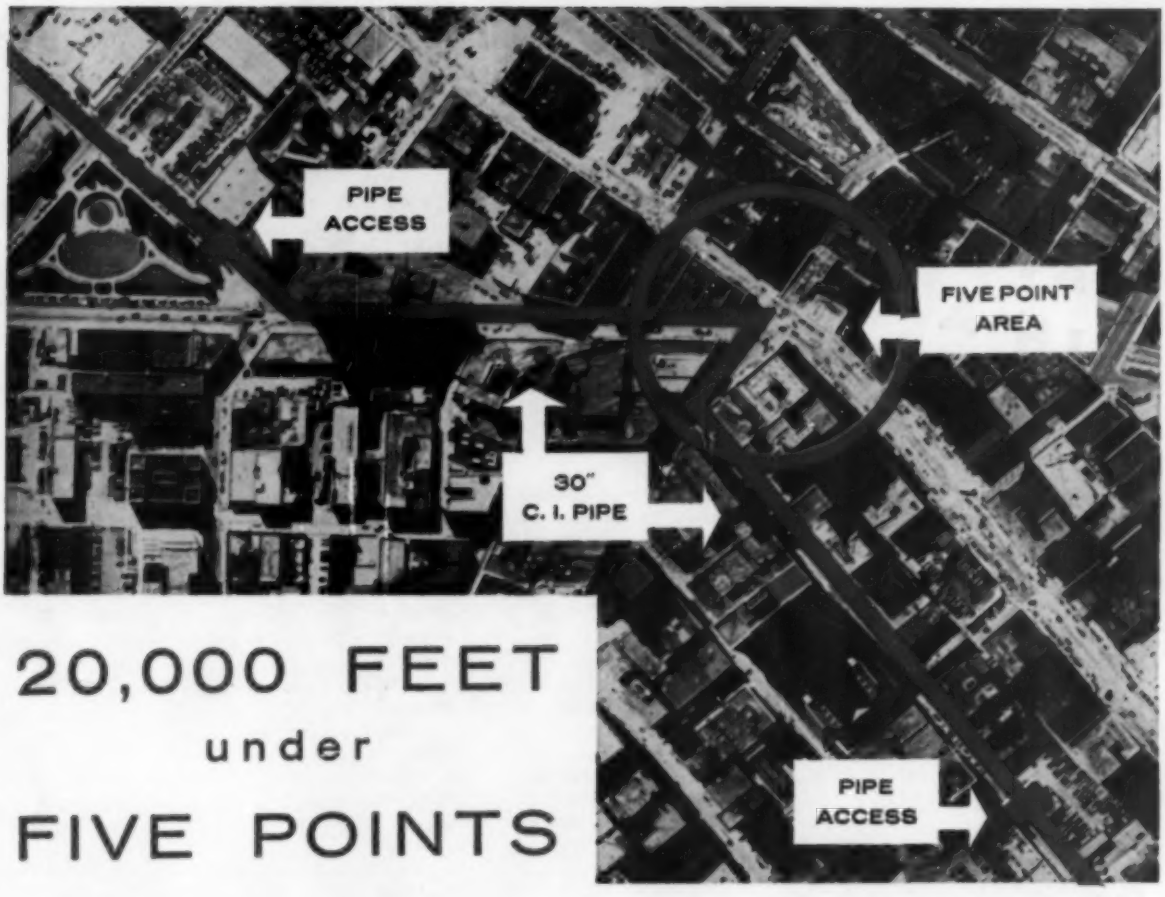
Oxidation Ponds and Sewage Lagoons

Reprints of the article on Oxidation Ponds and Sewage Lagoons, which appeared in the December issue of PUBLIC WORKS are available to state and local health departments and universities by writing E. R. Baker, Program Management Officer, Communicable Disease Center, Dept. of HEW, 50 Seventh St., NE., Atlanta 21, Georgia.



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SLOPE PAVING IN A RESERVOIR

● **TRUCK with spreader box was pulled up the sloping sides of the interior of the reservoir. Travel speed while paving was 50 to 60 fpm. Compaction was 25 to 30%.**

IN THE July, 1959, issue of PUBLIC WORKS, Paul W. Travis described the construction of a water storage reservoir at the City of Newport Beach.

This article provides additional information on the asphalt paving of the slopes. An aggregate made up of ¾-in. to #4 crushed rock and a binder asphalt of 50-60 penetration were used. Samples of the mixture were tested to make sure sufficient voids were present, after rolling, to give a pervious lining which would permit some upflow of ground water into the reservoir. This relieved any pressure that might have built up under the lining.

The slopes had 3:1 grades and lengths varied from 135 ft. to 150 ft. due to the irregular contour of the reservoir. The lining was placed in one layer to a minimum depth of 3 ins.

R. J. Noble, the contractor on the paving, used the following equipment and crew: Two D-7 Cats with side booms and winches, one controlling the trucks and the other the 6-8-ton Buffalo tandem finishing roller. Breakdown was done by a 3-5-ton Huber roller, controlled by a similar winch on a D-2 Cat.

Trucks were of all makes, mainly 10-wheelers carrying 12 tons. The winch bridle was connected to the ears on the truck bumpers. All were equipped with a chain grab or ½-in. hook mounted on the middle of the bumper for attaching the single pull chain from the spreader box. This box was a Watson-Cmetco Rola paver, weighing 1800 pounds, which was 9 ft. wide. Volume or thickness of material is controlled by a floating screed similar to that used on the heavy pavers. It was necessary to build up the back and sides of the box to prevent spillage due to the slope. This spreader box was not a new piece of equipment for the crew, as they had placed over 100,000 tons of asphalt with it in the preceding three years.

Foreman Robert McCowen was assisted by Dick Glen, plus four equipment operators, a screed man and helper, two rakers and two header men.

A total of 9,000 tons was placed on the slopes. This was laid at an average of 400 tons per day; top day was 489 tons. The corners, and especially the areas above and below the inclined access road, caused some delay, but the daily tonnage never went below 300.

To prepare the clay surface for paving, the slopes were fine graded by a Cat 12 motor grader, then rolled and compacted. Loose material still present was removed by using an air blast.

Header boards were required at both the top and bottom of the slopes. The lower header made a good screed rest to start from and kept the asphalt in place while rolling. The boards were all removed before paving the bottom and the top contour road.

The Paving Cycle

The paving cycle was generally as follows: The first truck picked up the box, using the pick-up chains supplied, and moved to the slope where it was attached to the cable and pulled into paving position. When the box was filled, the up signal was given and paving continued until the truck was empty or it was about 20 ft. from the top. Then the bed was lowered to allow the box to run out of material by the time it reached the top. Again the box was picked up by the truck and after making a few wiggles back and forth to move over 9 ft., it was lowered to the bottom for the next pass.

To provide room for the truck on the 20-ft. upper road during this move, the Cat operator simply stopped his winch and travelled down the outside slope of the reservoir. This gave a safety factor as the trucks were still connected to the tractor.

Travel speed while paving was 50 to 60 ft. per min. and this could usually continue without stopping until the truck was empty. Compaction was 25-30 percent or about half that provided by the Barber-Greene on the same material while floor paving.

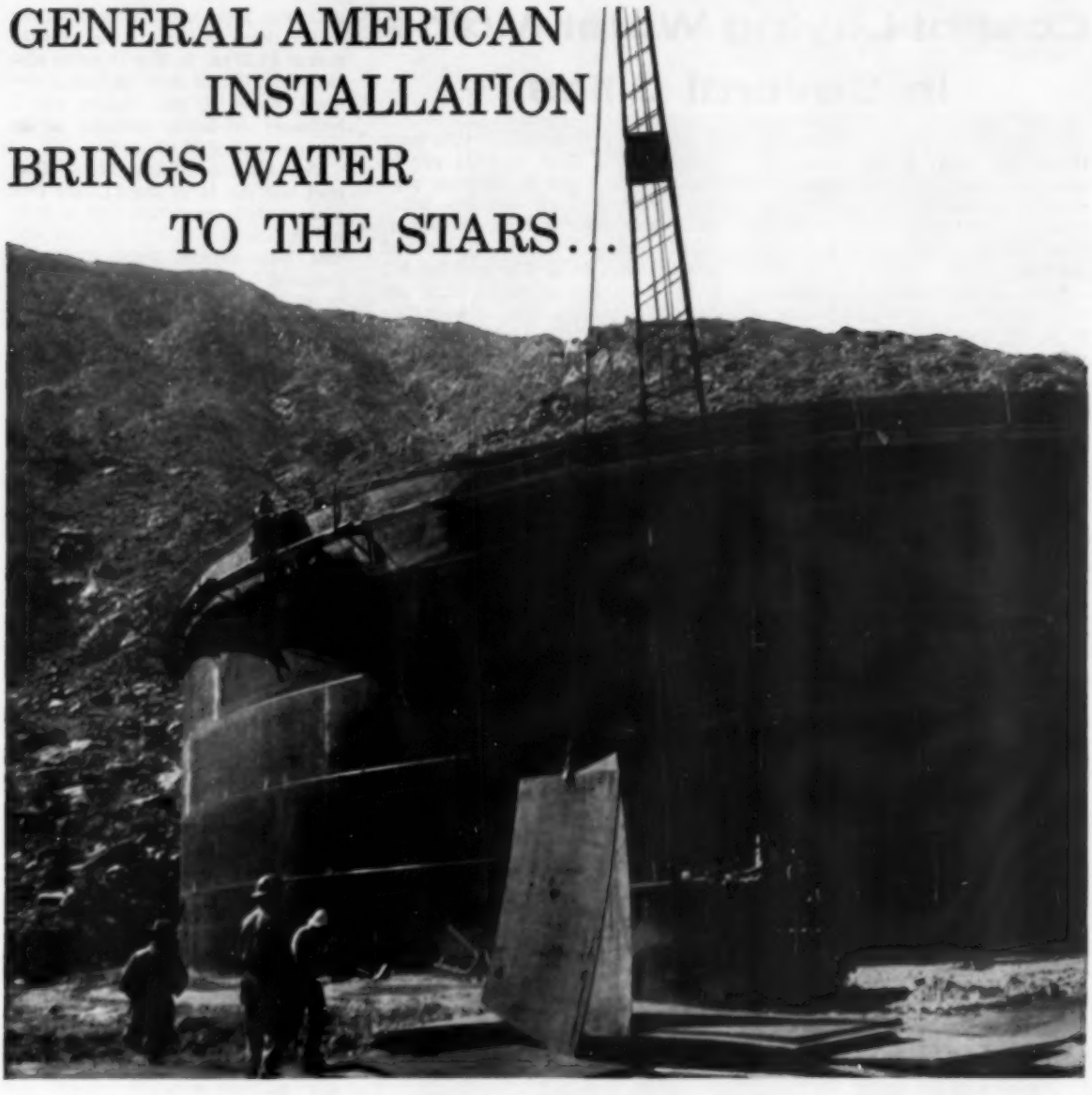
At the corners, the screed was overlapped on the previous hot pass as required and the box adjusted for the elevated wheel that ran in the asphalt. Pofi Duarte did a capable job anticipating these overlaps.

Above and below the permanent 20-ft. inclined access road to the floor of the reservoir, paving was done in two operations, one up to the road and one from the road up to the top. The D-7 remained at the crest at all times as there was no room for it and the trucks on the road.

Before paving, a liquid weed killer was sprayed over the clay base. After paving, a liquid chlorine solution was sprayed on the finished asphalt and allowed to permeate through the voids to sterilize the underlying clay foundation. A final thin coat of slurry concrete was brushed over the asphalt. This did not fill the voids.

A recent examination showed no cracks above the water line.

GENERAL AMERICAN INSTALLATION BRINGS WATER TO THE STARS...



Palm Springs is a thirsty city. In this desert playground of movie stars and sun-worshippers at the foot of water-rich Mt. San Jacinto are more gardens and swimming pools per capita than any other place in the world. Within the mountain are many underground streams. The problem was to tap the resources and store more water than existing reservoirs would hold. The answer—a 5,000,000 gallon tank fabricated in General American's shops, trucked to a hard-to-reach spot on the hillside and erected by a General American field crew.

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Cost of Laying Water Mains in Several Cities

According to the 1958 report of the Elmira, N. Y., Water Board, the costs per foot for laying water pipe were: For 7,659 ft. of 6-in., $5.16 per foot; for 2,087 ft. of 8-in. $8.33 per foot; and for 1,562 ft. of 12-in., $9.91 per foot.

In Lewiston, Idaho, according to the 1958-59 report, it cost $4.70 per ft. to lay 380 ft. of 8-in. pipe. Material cost was $1,219; excavation $185; laying the pipe $236.80; and backfill $145.20. On four jobs, 2,714 ft. of 6-in. pipe was laid, with costs ranging from $2.93 to $4.31 per ft. On two jobs, 552 ft. of 4-in. pipe was laid, costs on one job being $1.87 per foot, and on the other, which included 194 ft. of pipe and one hydrant, $4.31. The cost for 362 ft. of 2-in. pipe averaged $1.32 per foot. The average cost of installing 69 services, from ⅝-in. to 2-in. was $96.23 each.

Sacramento, Calif., Water and Sewer Division laid 1,692 ft. of 6-in. cast iron pipe, using 5 gate valves in the three sections, at an average cost of $4.25 per ft. The Division also laid 4,458 ft. of 6-in. asbestos cement, using 17 gate valves and 7 hydrants, in seven sections, at an average cost of $6.16 per ft.

The Auburn, Maine, Water District laid 900 ft. of 2¼-in. cast iron pipe at an approximate cost of $1.70 per ft. The 6, 8 and 12-in. pipe was cast iron, cement lined with mechanical joints. On nine jobs, 3,039 ft. of 6-in. was laid at an average cost of $3.61 per ft.; and 2,024 ft. of 8-in. was laid in five jobs at an average cost of $6.04 per ft. A line of 12-in., 1,054 ft. long cost $7.21 per ft. The Auburn Sewer District laid 1,499 ft. of 8-in. asbestos cement sewer pipe in three jobs at an average cost of $3.83 per ft.

As itemized in the 1958 annual report of the Kenosha, Wisc., Water Department, the cost of laying 6-in. water pipe, based on 14,309 ft., was $2.80 per foot. The cost per foot for 3,103 ft. of 8-in., was $4.00; for 1,560 ft. of 12-in., average cost was $6.27 per ft.; and for 312 ft. of 36-in. the cost was $307.03 per ft. The high cost on this short section of steel pipe was due to the nature of the work. This involved a river crossing, including the removal of a 24-in. line, excavating, driving piles, backfilling and constructing concrete buttresses and supports.

The average cost of making water connections at Kenosha was as follows: for ¾-in. copper, $29.71; for 1-in. copper $37.52; for 1½-in. copper $52.55; and for 2-in. copper $145.22. The water sold through meters and accounted for was 86.9 percent of the water delivered to the distribution system; and 89.3 percent of the total was accounted for. Per day per mile of pipe 58,454 gallons were delivered; per capita consumption was 136.6 gallons per day representing a population per mile reported as 372, and income per mile of pipe $4,885.68.

Cost of water mains constructed by Arlington Co., Va., during the fiscal year 1959 was as follows: For 10,852 feet of 6-inch pipe, $3.96 per foot; for 2,401 ft. of 8-inch pipe, $4.95 per ft.; and for 2,410 ft. of 12-in. pipe, $7.11 per foot. The average cost of making ¾-inch service connections was $108.34 based on 307 connections; for making 158 1-inch connections, the average cost was $130.09 each; for 11 1¼-inch connections, it averaged $159.07; for 22 1½-inch, the average was $281.05; for 22 2-inch, $562.53; for seven 3-inch, $1380.36; and for four 4-inch it was $1515.81.

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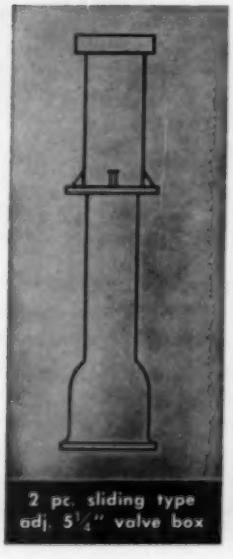
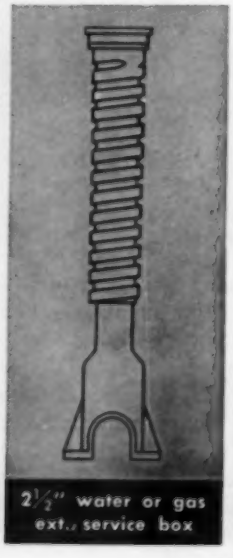
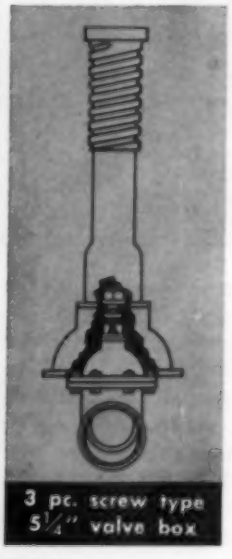


2 pc. sliding type adj. 5¼" valve box



2½" water or gas ext. service box



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THE
HIGHWAY
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DIGEST

Prepared by **FRANK FORCE,** ***Digest Editor***

Longest Plate-Girder Span in U. S.

The American Rapids Bridge, spanning the rapids of the Niagara River, has a main center span of 450 ft. and end spans of 70 ft. The center span consists of haunched plate-girders varying in depth from 16 ft. at the supports to 7 ft. at mid-span. The short end-spans are heavily counterweighted with concrete to form rigid composite beams providing fixity for the center span. Several advantages were achieved by providing continuity: 1) the structure can "breathe" freely and expand and contract in length with temperature; and 2) adjustments and movements at the supports could easily be made to accommodate closure, weighting and other erection operations. There are two 12-ft. traffic lanes designed for an H20-S16-44 truck loading, with a cantilevered sidewalk on each side. Three main riveted girders are spaced 11 ft. on centers. They are of medium manganese steel throughout. Each flange has four 8 x 8 angles with side plates and cover plates. Top bracing is provided throughout, and there is bottom bracing from the support to the fifth panel point. On the main span there is a 7-in. slab of lightweight concrete with 1-in. asphalt plank surfacing. Maximum use of digital computer equipment expedited the design.

"Longest Plate-Girder Span in U. S. Completed." By E. H. Praeger and T. C. Kavanagh, Praeger- Kavanagh, Engineers, New York, N. Y. *Civil Engineering*, December, 1959.

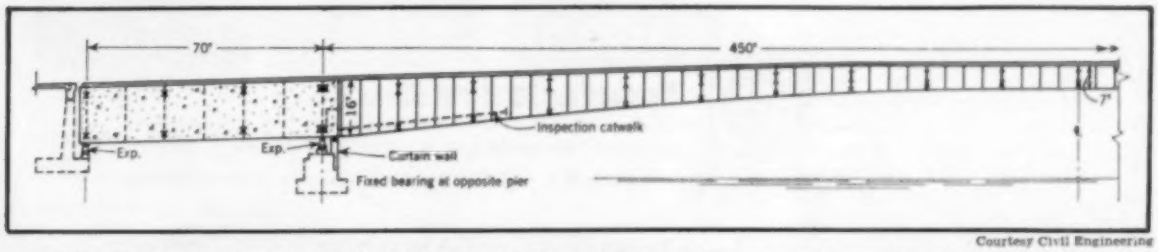
An Urban County's Traffic and Roads

The Essex County, N. J., Traffic Division is a subsidiary of the County Highway Department and functions directly under the Superintendent of Highways who is also the Deputy Supervisor of Roads. The Traffic Division consists of three departments: Traffic signal; sign; and street painting. There are 314 signalized intersections and this figure is annually increased by an average of eight. The following are types of signals used: Fixed time (1-dial, 2-dial and 3-dial) controllers; semi-vehicle and full vehicle actuated electronic dispatchers; full vehicle actuated volume density electronic dispatchers; electro-mechanical and electronic pedestrian demand controllers; and radar, magnetic and pressure sensitive vehicle detectors and counters. The Highway Dept. maintains 200 miles of roads interlacing 21 municipalities. There were 5,469 catch basins cleaned with 2,950 cu. yds. of dirt being removed. The road sweeping motorized crews swept 13,496 curb miles and removed 4,347 cu. yd. of dirt last year. Hand crews picked up 1,569 yards of sweepings. There are 2,000 bridges and culverts assigned to highway maintenance for servicing. Since the major portion of this repair is brick, stone and reinforced concrete, responsibility is allocated to the masonry section. There are 7,600 lineal ft. of snow fence erected each year; 26 snow plows and 25 ice control spreaders mounted on county equipment are used to fight snow and ice in the county.

"An Urban County's Traffic and Roads." By Daniel J. Murray, Highway Maintenance Supt., Essex County Highway Dept., Livingston, N. J. *The American City*, December, 1959.

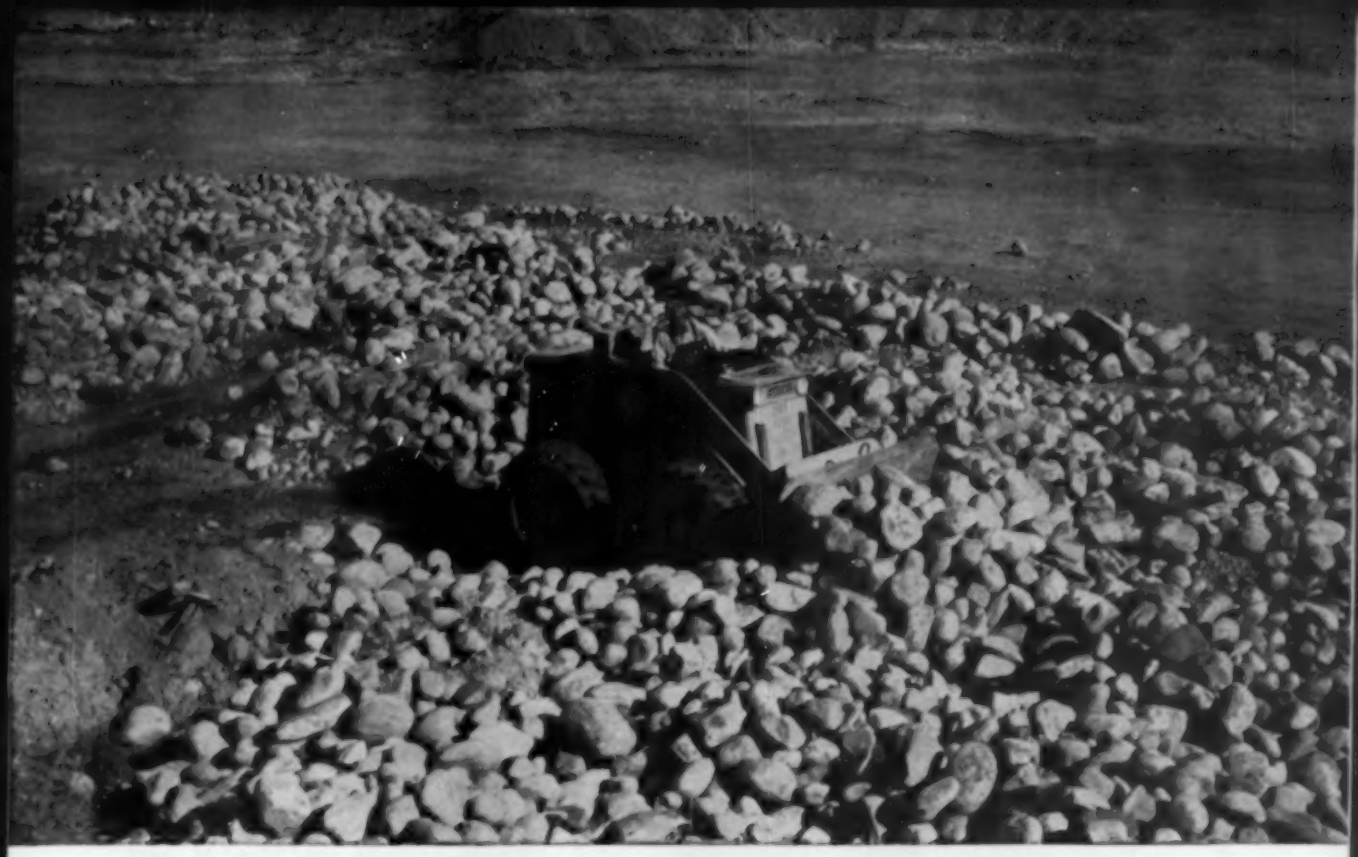
Welded Wire Fabric in Road Pavements

Steel reinforcement of portland cement concrete pavements is now required for state highway construction in 30 states. Reinforcement design for highway pavements is based on the "subgrade drag" formula which is expressed as $A_s = FLw/2f_s$. The coefficient of subgrade friction, F, is taken as an average of 1.5 for highway pavements; weight of slab averages 12.5 lbs. psf per inch of thickness; and the allowable working stress, f_s, depends on the type and grade of steel. In actual practice a working stress of 45,000 psi has been found satisfactory for wire fabric. Several other requirements must be considered in the design as follows: Longitudinal wires should not be smaller than No. 2 gage and the spacing should not exceed 12 in.; transverse wires should not be smaller than No. 4



Courtesy Civil Engineering

● **SECTION through American Rapids bridge. The 450-ft. center span is longest continuous plate girder span in the U. S.**



Cuts costs on rock-loading and other scattered jobs

Canadian city operates two Michigans for $3.70 hourly

By loading rock and other tough materials fast, two Model 75A Michigan Tractor Shovels have substantially cut earthmoving costs in Calgary, Alberta.

The City's two 80 hp 1¼ yd Michigans work for about half as much as the fleet of industrial tractors, belt loader, and 90 hp crawler-loaders they replaced. They waste less time between jobs, too.

Take the pictured task as an example.

On one of its typical "tough jobs," Michigan picks up boulders (big picture), loads them into trucks (above) for haul to river dike.

Michigan speeds to job

Here, a fleet of trucks was waiting to start hauling rock for river dike construction. Obviously, this was a loading job much too tough for industrial tractors. Also, the pit was too far away for a crawler to be trucked in soon. So, the call went out for one of the Michigans.

The closest one drove in rapidly from a gravel pit. Its four-wheel-drive and 8,000 lb lift capacity paid off immediately. Two minutes, four passes, heaped each 5-yard (3 ton) truck. At this rate, the boulder-handling job was soon over . . . and the Michigan in minutes was driven back to its original assignment. Waste time was minimized . . . costs per hour decreased . . . the City's $8,500,000 public works budget (for 215,000 people) stretched.

7,375 working hours: 98.9% availability

Two and a half years operation of this type—heavy jobs, light jobs, freezing cold, dust, rain, road-building, snow-plowing, dirt-salt-gravel loading, etc, etc—7,375 Michigan working hours in all—have cost the City of Calgary only $13,619—an average per hour of $1.85 (including fuel, lubrication, tires, repairs, and depreciation).

Remember, this cost averages all sorts of jobs, *including* rock-loading! (Operators wages are not included; the City charges this cost to the department as a whole, not to a specific machine.)

Even if you *do* include wages against the Michigans, we're sure you'll agree they are being operated very reasonably. Could Michigan's speed, mobility, and ruggedness help you? We'll be glad to demonstrate so you can judge for yourself. See your Michigan Distributor to arrange a date. His name, address and phone number are listed in your regional construction magazine.

Michigan is a registered trademark of

CLARK EQUIPMENT COMPANY
Construction Machinery Division

CLARK EQUIPMENT

2499 Pipestone Road
Benton Harbor 18, Mich.

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Canadian Clark, Ltd.
St. Thomas, Ontario

gage and the spacing should not exceed 12 in.; reinforcement should be placed a minimum of 2 ins. and a maximum of 1/3 the slab thickness below the top of the pavement; steel should not extend through the contraction or expansion joints; and laps, where necessary, should be not less than the spacing of the wires. Proper handling and placing of welded wire fabric will simplify paving operations and insure maximum production. There are two types of fabric reinforcement, continuous and strip, used when placing a reinforced asphaltic concrete overlay on a rigid pavement. Continuous reinforcement should be used when the slabs have numerous corner cracks, closely spaced transverse cracks between the usual joints and longitudinal cracks in combination with transverse cracks and joints. Strip reinforcement should be used when the slabs are intact and the only breaks in slab continuity are the transverse joints; when the slabs are in good condition except for occasional transverse cracks; and when a longitudinal joint is formed by the widening of the existing pavement, The most commonly used styles of fabric are 3 x 6 — 10/10 and 4 x 4 — 10/10. These are furnished either in sheets or rolls and conform to AASHO specifications. In asphalt construction, the welded wire fabric should be placed between the leveling course and the binder course or between the binder course and the surface course. The thickness of the asphaltic concrete course covering the fabric should not be less than 1¾-in. compacted.

"Welded Wire Fabric in Highway Construction." By Henry Aaron, Chief Engineer, Reinforced Concrete Pavement Div. and Edward Howard, Field Engineer, Wire Reinforcement Institute. PUBLIC WORKS, January, 1960.

STANDARD STEEL "S-J"
Maintenance Distributor

for VERSATILITY — EFFICIENCY — ECONOMY

HANDLES ASPHALT OR TAR—FOR PATCHING—SEALING—RESURFACING—CRACK FILLING—OR SURFACING DIRT OR GRAVEL ROADS

WORKS FAST—FAR AHEAD OF THE GRAVEL GANG

Standard Steel S-J Maintenance Distributor, designed specifically for jobs where the use of bigger equipment is costly and impractical, can be moved rapidly from one location to another for patching, shoulder repair or construction of secondary roads . . . It is equipped with suck back spray bar which permits closing of the discharge valve and pulling back all surplus material in the spray bar and piping for quick cleaning . . . All piping and valves are flanged to permit easy repair or replacement . . . The draw off valve is on curb side for safety . . . and coilless self-generating burners are standard equipment as well as a Viking special asphalt pump which can be completely drained, eliminating the necessity for thawing when the unit is started cold. Write for complete details on Model S-J.

OTHER PRODUCTS OF STANDARD STEEL
ASPHALT DISTRIBUTORS . . . BURNERS . . . POWER AND TRACTION DRIVEN CONSTRUCTION BROOMS . . . MAINTENANCE DISTRIBUTORS . . . TAR KETTLES . . . AGGREGATE SPREADERS STREET FLUSHERS . . . PIPE LINE EQUIPMENT . . . SUPPLY TANKS SHELVING HARDWARE . . . AND AGRICULTURAL EQUIPMENT

Built to The Highest Standard

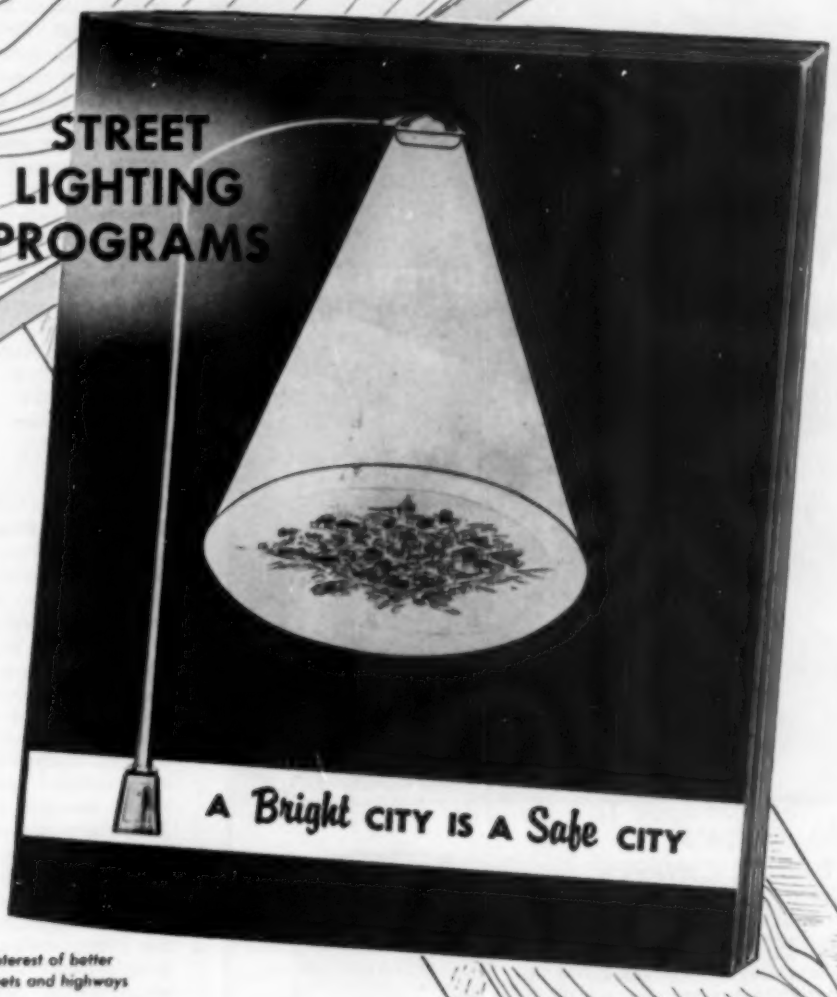
Standard Steel Works, Inc. NORTH KANSAS CITY, MO. S-7

Maintenance of County Highway Equipment

The maintenance of equipment required to construct and maintain 1,623 miles of county road calls for a smooth working crew of operators and maintenance men. Each motor grader purchased by Marion County, Kans., must be kept in operation for an average of 15 years. The firm from which the machine is purchased must have repair parts in stock over a long period of years. The county makes a complete repair job on a piece of equipment once it is torn down. In preventive highway maintenance, it is always wise to match the machine with the work at hand. In the purchase and maintenance of truck equipment, it is the policy to buy the trucks locally for two reasons: The local dealers carry a complete line of repair parts and make them available to the county at a discount and they maintain adequate shops for repair in time of need. The county shop building is 71 ft. wide by 121 ft. long. The shop section is on the south side of the building and the area north of the shop section houses the parts room, toilets, tire room, laboratory, concrete culvert construction shop, employees briefing and tool room, two truck storage spaces, and welder's steel supply room. The shop section consists of three repair stalls, one welding and machine shop stall or area and one washing and greasing stall. The stalls themselves are 36 ft. deep and the doors are 12 ft. wide by 12 ft. high. The shop itself is equipped with a valve grinding machine; brake shoe machine; heavy drill press; metal lathe; 80 ton-press; electric and gas welder; portable electric welder; column grinder; anvil and an assortment of tools and small equipment. The shop is manned by a foreman, a welder-

free guide

to Planning and Promoting . . .



Published in the interest of better lighting for our streets and highways

Here is help for those planning street lighting programs. Our new 20-page guide, entitled "A Bright City is a Safe City", contains charts and tables on traffic volume, light intensities, pole spacing, mounting heights and other valuable information. It also describes and illustrates re-lighting programs of specific cities and towns. Just write us—on your letterhead, please—for your copy. Address: Dept. P-2

KERRIGAN
IRON WORKS COMPANY
Nashville, Tennessee

Subsidiary of ROCKWELL–STANDARD Corporation

STREET LIGHTING & TRAFFIC SIGNAL STANDARDS—SIGN STRUCTURES—IN STEEL & ALUMINUM

mechanic and a mechanic. A pickup truck is available for use in the field. Only minor repairs are made in the field, as routine maintenance reduces emergencies.

"County Equipment Maintenance." By James F. Meisner, Marion County Engineer, Marion, Kans. PUBLIC WORKS, January, 1960.

Automatic Sign Painting System

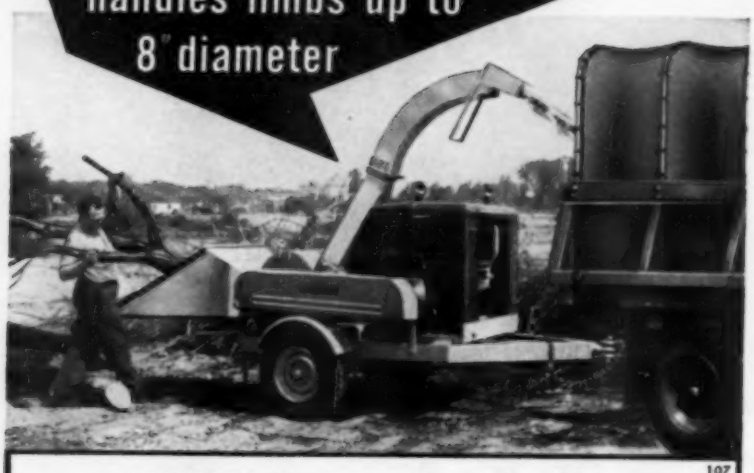
The job of painting 100,000 street and traffic signs, the estimated output of Chicago's Sign Division for the year 1959, has been made relatively easy by an automatic spray painting system. Installation of a conveyorized spray painting system, coupled with precise production timing control, has made the production self-contained. The spray painting facility is planned around a set of Binks spray booths. Each booth is equipped with a Binks vertical reciprocating spray machine, each with two model 21 spray guns. A panel about 1 x 2 ft. can be painted on one side in about 10.5 secs. After the panel has passed through the second booth it continues by conveyor to an overhead gas infrared oven. It travels through the oven for 12 mins. at a temperature of 340°F. Ninety percent of the lettering or application of the legend is done by silk-screen process. Operating controls for the entire system are housed in three panels. Two panels control oven temperature and are fitted with recorder-controller instruments. The third panel houses the timers and electrical circuitry to actuate the spray guns at the right time, and to control the motion of the entire reciprocating unit. Before going to the painting operation, each panel is put through a five-stage washer. The first step is for degreasing, using a mild alkaline cleaner. Next comes a hot water rinse for 60 secs. at 160°F, followed by a phosphating process, applied for 60 secs. at 160°F. The fourth step is an unheated water rinse for 30 secs. and the fifth, is an acidulated rinse for 30 secs. at 160°F. The application of the primer coat is a dip process using zinc chromate primer.

"Chicago's Automatic Sign Painting System." By Don R. Crowell, Traffic Engineer, Sign Div., City of Chicago, *Street Engineering*, December, 1959.

Analysis of a City Engineering Department

Under the City Charter, Seattle's Board of Public Works consists of four members: Supt. of Buildings; the Supt. of Lighting; Supt. of Water; and City Engineer. The Board takes public bids on all new construction work. All street uses and occupancies are their direct responsibility. The Board issues permits for such requested uses when it is deemed compatible with the public interest. All meetings of the Board are open to the public. Administrative responsibility for the four main city departments is delegated to the four members of the Board. The successful operation of the Engineering Department is largely dependent on the direction exercised by the capable staff of career civil servants. The numerous and widespread responsibilities of the department require seven major divisions with a total of 1,125 people on the payroll. The seven divisions are as follows: 1) Construction Division which supervises all new construction in the city and includes the computing and surveying section and the testing laboratory; 2) Design and Plans Division which makes preliminary engineering studies and reports and prepares construction plans, specifications and estimates for all engineering work; 3) Office Engineering Division which

POWERFUL, NEW
M&M BRUSH CHIPPER
handles limbs up to 8" diameter



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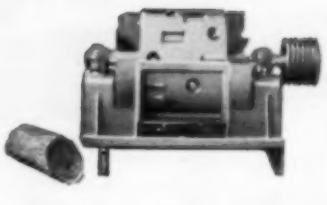
AMERICA'S
NO. 1 BRUSH CHIPPER

M & M's exclusive design of small, staggered and tapered cutting knives in the large cylinder allows chips to be *shaved off . . . not cut off*; makes it possible for this new chipper to handle 8 inch logs without creating impact shock responsible for damaging bearing and clutch wear.

Unique twin-bar design allows the chipper to produce either large or small chips . . . a profit-making feature, since small chips have many uses.

The heavy-duty M & M chipper has a built-in blower to regulate direction and distance of chips. Large, heavy rotating cylinder in between heavy-duty roller bearings eliminates overhanging flywheel. All-welded, special alloy steel construction



of simple design assures trouble-free operation and low maintenance costs.

With the addition of this heavy-duty model, Mitts & Merrill manufactures a complete line of chippers in sizes and capacities for any brush disposal requirement. Write today for complete information.

LARGE AND SMALL M&M HANDLES THEM ALL!

MITTS & MERRILL • 1005 So. Water Street • SAGINAW, MICHIGAN

BUILDERS OF WORK-SAVING, MONEY-SAVING AND MATERIAL RECLAIMING MACHINERY SINCE 1854

is responsible for liaison with the City Council, assists the Law Department, prepares assessment rolls and maps and acquires rights-of-way; 4) Traffic Engineering Division which comprises four sections including traffic surveys and studies, traffic planning, traffic operations design and traffic signals and lighting; 5) Office Administration Division which handles personnel, establishes the annual budget and does all accounting work; 6) Maintenance and Operations Division which handles street maintenance, sanitary operations and street use and permits; and 7) Sewerage Utility Division which maintains and operates the four sewage treatment plants, pumping stations and sewer lines.

"Analysis of a City Engineering Department Shows Broad Scope of Duties and Responsibilities." By Roy W. Morse, Chairman Board of Public Works and City Engineer Seattle, Wash. PUBLIC WORKS, January, 1960.

Maintenance of City Streets

San Antonio's 2,000 miles of streets are 450 miles graveled, 300 miles dirt graded or unopened streets and the balance paved surfaces, largely asphalt. A seal coat program was initiated in the summer of 1958. This included placing a protective asphaltic covering over about 130 miles of paved streets. The seal coating program for 1959 included approximately 112 miles. The maintenance of gravel surfaced streets has been a problem and an experimental program was initiated early in the 1959 spring. A single-course asphalt penetration surface was placed on newly graded and rolled streets. To date, about 1,900 blocks have been improved with city-owned equipment. The seal coating programs of 1958 and 1959 were done both by contract and with city-owned equipment. The bituminous material used in seal coating is applied at 300°F. The cover stone is pre-coated crushed limestone graded from ½-in. max. to 100 percent retained on a 40 mesh sieve, and coated or fluxed with 1 percent of asphalt material to eliminate dust. The cover stone for the single course asphalt penetration on the gravel streets has been of approximately the same gradation, but uncoated, and is either washed or crushed material. The Street Maintenance Section is divided into five major districts and geographical areas, each headed by a Street Maintenance Supervisor. Another

SIMPLICITY OF OPERATION
key to low cost, popular (MB) packer bodies

Compacts all types of refuse—easier, faster

Packer plate pushes out load—safely, quickly

M-B Packer Body simplicity of design and operation can save you hundreds of dollars in lower initial investment, in faster collection, and in lower operational cost. The square, van-type body design eliminates dead weight caused by complicated hydraulic systems and heavy tailgates — allows mounting on low-cost, smaller size truck chassis. The new M-B vertical bulldozer-type plate completes the packing cycle in seconds — pushes out the load just as fast, without raising body. And, you pile up savings from lower operating and maintenance cost because of the smaller truck and simple, trouble-free packing mechanism. There's a size for every need from 14 to 38 cu. yd. See your distributor or write the M-B Corp., New Holstein, Wisc. Dept. PW.

Street Supervisor is in charge of the asphalt paving crews, which are assigned throughout the city on schedules as grading work becomes ready or areas are established for seal coating. Each crew has a Foreman in charge.

"Big P M Program for San Antonio Streets." By C. W. McKennon, Jr., Street Maintenance Engineer, San Antonio, Tex. *Street Engineering*, December, 1959.

Dome Structures

This special staff report on dome structures covers the engineering aspects and the different materials that are used in building these structures. The articles listed in this symposium are as follows: "A Philosophy of Space and Shape," by R. Buckminister Fuller, discloses the theory underlying his geodesic structuring and shows how his approach led to the discovery that geodesic structures give an improved ratio of strength to weight as the volume enclosed is increased; "A Reconstruction Contrast in Technologies," by Herbert David, gives data on St. Hedwig's Cathedral in East Berlin; "Engineering Aspects" gives the details on employing domes for uses other than churches or monumental buildings; "Designs in Metal" discusses advantages of this type of material in speed of erection, requiring a minimum of scaffolding, reduced weight and structural adaptability to the strain of concentrated loads; "Designs in Concrete" discusses the application of thin shelled domes which offer a pleasant appearance, smooth surfaces, structural rigidity and negligible maintenance costs, but do have high form costs—also being used are precast concrete and post-tensioned shell dome structures; and "Designs in Wood & Other Materials" points out that domes are quite popular in school construction and for use as auditoriums and gymnasiums; other materials include a wide range of plastics and corrugated paperboard.

"Dome Structures." *Consulting Engineer*, December, 1959.

Bituminous Stabilization

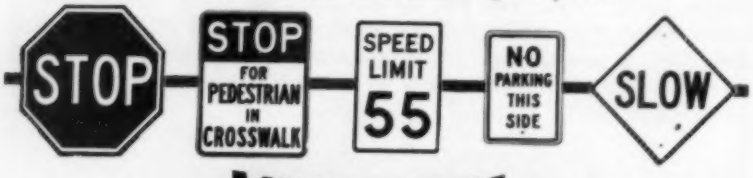
An example of asphalt base stabilization making possible the use of local aggregates is presented on Route 24 in El Paso County, Colorado. Laboratory tests on aggregate from a local pit indicated that the material was suitable for use in an asphalt stabilized base and an asphaltic surface course. A typical section shows a 24-ft. roadway with a 10-ft. shoulder on each side. The 4-in. asphalt stabilized base extends from shoulder to shoulder, a width of 44 ft. The asphaltic surface course is 24 ft. wide by 1 in. deep and is covered with a seal coat. The asphalt contents were 5.0 percent for the base and 6.0 percent for the surface course. The base was placed in one layer the top of which was lightly indented by the feet of a sheepsfoot roller. The indentations provided a roughness to interlock the surface course and base. Also, a tack coat was applied before the surface course was laid. The same asphalt which was used for the base and surface course (120-150 pen.) was used for the seal coat. The ¾-in. maximum size limestone chips were heated to 300° to 325° immediately prior to the spreading operation. A test section using 4,000 gal. of rubberized asphalt was laid as a seal coat. This type of rubberized asphalt utilizes 1½ percent neoprene for the rubber phase.

"Bituminous Stabilization Saves Costly Material Import." By E. G. Swanson, Staff Materials Engineer, Colorado Dept. of Highways. *Roads and Streets*, December, 1959.

SIGNS tell a Lot
ABOUT A COMMUNITY

EMBOSSED MIRO-FLEX TRAFFIC CONTROL SIGNS
ARE SIGNS OF PRIDE!

It's a sign of wise buying when a community standardizes on Miro-Flex street name assemblies and traffic control signs. These long-life, embossed signs are uniform, more legible and last years longer than plain, flat-surfaced signs. Miro-Flex can provide signs for any purpose — with either standard or special messages. Find out today why you save for years and years with Miro-Flex. Write for free catalog and prices.



THE MIRO-FLEX CO. INC.
1824 EAST SECOND • WICHITA 14, KANSAS
Standard Traffic Signs Available for Immediate Delivery at Northeastern Warehouse
Koontz Equipment Corporation, 325 Ohio River Blvd., Emsworth, Pittsburgh 2, Pa.

the reason more and more water systems standardize on **MUELLER®** *gate valves:*

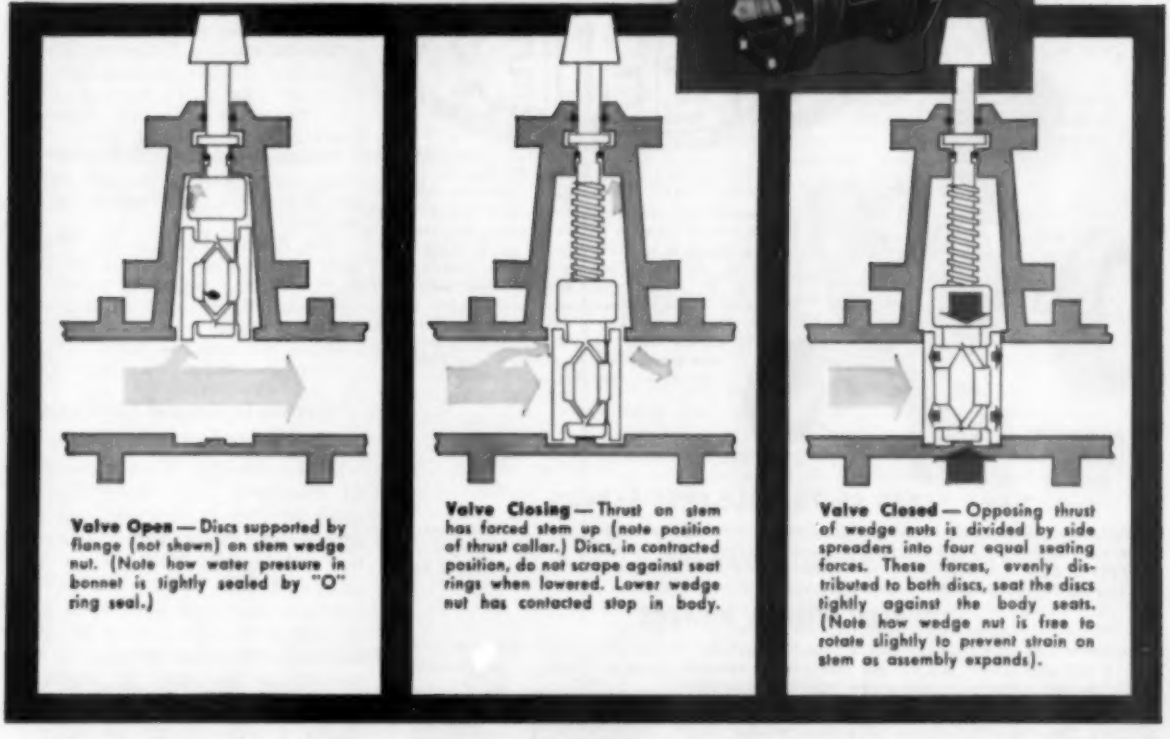
TIGHTER SHUT-OFFS TROUBLE-FREE OPERATION MINIMUM MAINTENANCE

. . . These are just a few of the benefits you get from installing Mueller double-disc, parallel-seat valves with exclusive "4-Point" wedging mechanism design.

The drawings below illustrate the principle. Torque applied to the valve stem is resolved into a vertical wedging force by the upper and lower wedge nuts. Side-spreaders transfer this force into a horizontal action and apply the force at four points on each gate disc.

Uniform seating loads are developed, eliminating disc distortion and deflection. Tighter, positive shut-offs are assured.

Here's how the "4-Point" mechanism works.



Valve Open — Discs supported by flange (not shown) on stem wedge nut. (Note how water pressure in bonnet is tightly sealed by "O" ring seal.)

Valve Closing — Thrust on stem has forced stem up (note position of thrust collar.) Discs, in contracted position, do not scrape against seat rings when lowered. Lower wedge nut has contacted stop in body.

Valve Closed — Opposing thrust of wedge nuts is divided by side spreaders into four equal seating forces. These forces, evenly distributed to both discs, seat the discs tightly against the body seats. (Note how wedge nut is free to rotate slightly to prevent strain on stem as assembly expands).

Other bonus features — "O" ring stem seals *above and below* thrust collar . . . life-time lubricant completely surrounding thrust collar and sealed in by "O" rings . . . high tensile bronze stems with strong, electrically upset-forged thrust collar . . . sizes over 18" have extremely high-strength, cast manganese-bronze stems . . . complete line of end connections . . . full range of sizes.

Write for complete information and specifications.

MUELLER CO.
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Factories at: Decatur, Chattanooga, Los Angeles
In Canada: Mueller, Limited, Sarnia, Ontario

Other Articles

"Foamed Asphalt Gets Parking Lot Tryout." Street Engineering, December, 1959.

"Alton on the Upgrade." An Illinois city shakes off complacency and takes **active steps toward needed civic improvements."** By Graham W. Watt, City Manager, Alton, Ill. The American City, December, 1959.

"The Snowfall Probability Factor." How to use it to reduce snow and ice removal costs. By J. C. Thompson, U. S. Weather Bureau, Washington, D. C. The American City, December, 1959.

"Foamed Asphalt." By the use of this new process developed at the Bituminous Research Laboratory of Iowa State University, three new paving mixes were laid commercially and tested in the City of Dubuque, Ia. The new mixes include a liquid-mastic asphalt paving mixture for thin-layer resurfacing, an asphalt-cement slurry seal, and a long-time stock-pile patch material that can be placed in wet and cool weather. By K. J. Cullen, City Engineer, Dubuque, Ia. The American City, December, 1959.

"World's Largest Precast Prestressed Concrete Bridge Completed." Design and construction of the Narrows Bridge over the Swan River at Perth, Western Australia. The Surveyor, November 14, 1959.

"Control of Storm Water on the Ohio Turnpike." It is the belief that a properly functioning, well maintained drainage system is the key to the successful maintenance of the Ohio Turnpike. By L. G. Byrd, Maintenance Engineer, Ohio Turnpike Commission, Berea, Ohio. PUBLIC WORKS, January, 1960.

"Highway Sign Materials and Maintenance." **The backbone of roadway signing** on the New Jersey Turnpike is the side-of-the-road post-mounted sign. By John R. Crosby, Traffic Engineer, New Jersey Turnpike Authority. PUBLIC WORKS, January, 1960.

"Aerial Photography and Photogrammetry." By E. L. Sherertz, Engineer of Design, Illinois Dept. of Public Works and Buildings, Div. of Highways, Springfield, Ill. PUBLIC WORKS, January, 1960.

"Lime Slurry Upgrades Poor Subgrade Soils." Roads and Streets, December, 1959.

"Organized Labor's Newest Frontier Municipal Employees." By Raymond M. Urquhart, Village Administrator, Bronxville, N. Y. Mayor and Manager, December, 1959.

"The Electronic Digital Computer As an Aid in Road Location." By P. O. Malone, Assistant Engineer, Rendel, Palmer and Tritton, Consulting Engineers. Roads and Road Construction, November, 1959.

"Weedkillers on Motorway Reduce Verge and Reserve Maintenance to a Minimum." By R. C. Jennings, Chipman Chemicals Co. Ltd. Municipal Engineering, December 4, 1959.

"Vibration Densifies Loose Sand." By James Owen Power, Dignum Associates, Miami, Fla. Civil Engineering, December, 1959.

"The Role of the Highway Department in **Attack and Survival."** By B. H. Phillips, Senior Journalist, Travel and Information Division. Texas Highways, December, 1959.

• • •

Increase in Annual Per Capita Water Consumption

In the excellent annual report of the Pasadena, Calif., Water Department for 1958-59, it is reported that annual per capita water consumption per day was 192.8 gallons. This compared with 186.6 gpcd for the previous year and with 119.5 gpcd for the year ending June 30, 1942. This represents an increase of 61.3 percent in the past 17 years or about 3.6 percent per year.

High and Low Water Use Rates

Maximum hourly use of water in Milwaukee, Wisc., in 1958 was approximately four times the maximum daily use. Low daily pumpage, April 6, was at the rate of 58,020 gpm; high daily pumpage, Aug. 6, was 156,300 gpm; but the high hourly use, 2 PM July 25, was at the rate of 236,730 gpm.

Budget Call for MORE Tractor --- at LESS Cost?

SPEEDEX

SPEEDEX Tractor Co., Ravenna, Ohio

Model S-23
9 hp. $475. list

SPEEDEX is your perfect answer! The Big 9 h. p. SPEEDEX Tractor, Model S-23, shown at left compares favorably in performance and power with nationally-known farm tractors—at half the price! Briggs & Stratton engine, 2 power ranges, 1/4 to 10 m.p.h., geared reduction steering wheel, 7" x 16" tires, easy lift tool lever, TIMKEN bearing transmission—these are just a few of its features. This is the latest improved model of SPEEDEX Tractors that have given outstanding service since 1935—far better now than ever before.

MANY YEARS OF TROUBLE-FREE SERVICE

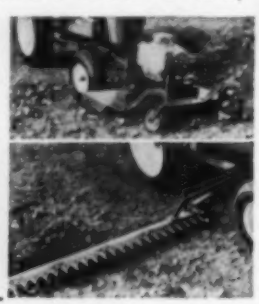
SPEEDEX owners constantly write telling of complete freedom from breakage troubles. Many have reported twenty years use without replacing even a belt! There's a good reason—every SPEEDEX is BUILT TO LAST—every part is made many times stronger than it will ever need to be. You can depend on SPEEDEX—proven by our full year guarantee.

CHOOSE FROM 5 MOWERS

In addition to the sickle bar mowers (30" & 42") and the 4½ h.p. self-powered rotary mowers (36" & 44") shown, there is a 30" reel mower (front-mounted), choice of "Yardman" or "Pennsylvania" 3-gang reel mowers, and a new underneath-the-tractor rotary.

SPEEDEX "Unit-Design" Tools are all heavy-duty—made to fit and work efficiently—and to require minimum service. All are guaranteed one year.

Try a SPEEDEX Tractor this year—give it the most severe tests your work can require. It will prove itself and convince you that a SPEEDEX fleet investment is a wise and thrifty decision.



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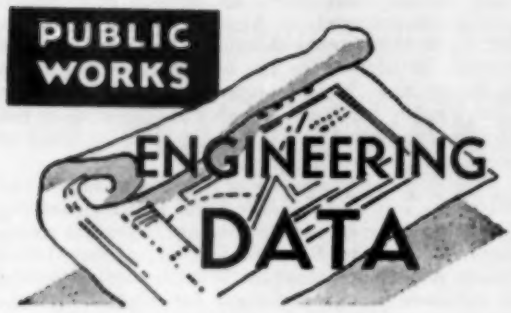

Charges for Permit Fees and Plan Reviews

The Metropolitan Sewer District of St. Louis, Mo., of which William Q. Kehr is Executive Director, has increased charges for permits, inspections, surveying and plan reviews in order to make these services self-supporting. Permit fees for connections have been increased from $4 to $9 and for repairs from $5 to $9, both including inspection; and for construction, including plat location from $2 to $20. Construction inspection is now $6 per hour for subdistricts and $4 per hour for subdivisions. For surveying, the party chief is now charged for at the rate of $6.50 per hour and engineering aids I, II and III at $4, $4.50 and $5 per hour respectively. Subdivision plan review charges have been increased materially. For one acre the fee is $48; for 5 acres $160; for 10 acres $236; for 20 acres $331; for 50 acres $499; for 100 acres $576; and for each acre in excess of 100, a 50-cent charge is made.

Costs of Garbage Collection and Disposal

The average cost of garbage collection and disposal in Raleigh, N. C., for the fiscal year 1958-59 was $1.40 per cubic yard or $4.33 per capita. The total handled amounted to 273,479 cu. yards; 97 men were employed, including 3 bull-clam operators, one at each of the three sanitary landfills.

The cost for street cleaning and hauling trash and yard trimmings was $1.15 per capita. During the 1957-1958 budget year, timing instruments were installed on all street sweepers. These show the time the motor is started and the time the sweeper is in actual operation; also whether or not the motor is running when the machine is standing still. In street cleaning work, 13,527 curb miles were swept and 14,037 street miles were flushed using 27,147,240 gallons of water. A total of 7,075 loads of trash, tree trimmings, etc. were hauled.

Warren J. Mann is Director of Public Works of Raleigh.

Eastern Equine Encephalitis

The New Jersey State Department of Health reported an outbreak of eastern equine encephalitis occurring during the month of September, 1959. A total of 29 clinically diagnosed cases with 19 deaths have been reported. Definite serologic confirmation of diagnosis has been obtained in two cases, and in three others the presumptive serologic tests were positive. The cases and deaths were reported from six counties in the southern half of the state and occurred mainly in old persons and the very young. The case fatality rate of 65% is not unusual for this type of viral encephalitis. The patients lived in rural wooded areas 5 to 10 miles

ESSICK
VIBRATING COMPACTORS

ESSICK VR-28-W PATCHING ASPHALT IN GARDEN GROVE, CALIF.

"MAINTENANCE PRODUCTION TRIPLED...
...COSTS DECREASED 80%"

SEWARD H. DART, STREET MAINTENANCE SUPERINTENDENT-SHOWN WATCHING HIS 28" ESSICK VIBRATING COMPACTOR IN ACTION—STATES:

"Irrigation water tracked into the intersections and gutter aprons in Garden Grove, constantly eroded the asphalt and made maintenance a full time problem. As a result, our gutter and intersection patching required frequent reworking, and our costs were high.

"After a demonstration of the 28" Essick Vibrating Compactor, we knew we had found the answer. It was self-propelled, hooked on the tail gate of a dump truck, and produced compaction equivalent to an 8 ton roller on asphalt. Its high frequency vibration compacts an asphalt patch that is completely dense—that can be opened immediately to traffic without any marking or damage to the asphalt.

"Now with our patching unit consisting of the 1½ ton dump truck, an Essick 120 gallon Truck Mounted Emulsion Unit, a propane torch, and the Essick VR-28-W Vibrating Compactor, the patch life has been tremendously extended, our maintenance production has tripled, and our costs have decreased 80%.

"The Essick VR-28 really solved the patch problem for us."

SELF PROPELLED — MANEUVERABLE — PORTABLE

Essick High Frequency Vibrating Compactors are constantly exceeding the densities and specifications performed by other compaction methods, while creating new standards of compaction for all types of fills, sub base, base materials, and asphalt.

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Also 14 models of Tandem Rollers from ½ to 14 Tons

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Affiliated with THE T. L. SMITH COMPANY, Milwaukee, Wisconsin

How Mud-Jack® *stabilizes sub-grades*

Sunken street and highway slabs, bridge-approach slabs, settled sidewalks, curbs and gutters can be corrected — *without* costly reconstruction. Koehring® Mud-Jack pumps soil-cement slurry under pressure into small holes drilled through pavement. This displaces air pockets, water or water-saturated materials, raises the concrete slab, leaves firm *permanent* sub-grade. Mud-Jack comes in 2 sizes for city and highway work. Ask for a free demonstration.

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REVERSIBLE • ONE-WAY • V-PLOWS • RIGID PLOWS

Good Roads Snow Plows perform smoothly and efficiently under the most adverse snow removal conditions. These rugged, heavy-duty plows are engineered to provide safe, speedy snow removal on highways, roads, streets, parking lots and airports.

Model 100 Reversible and 700 One-Way Plows are equipped with the exclusive Good Roads spring-cushioned, safety-blade trip device with automatic return for safe plowing at high speeds, protecting men and equipment. Model 150 and 750 Series Plows have basic open-type trip spring.

For further information on models available, write:

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from the sea coast where an increase in mosquito population occurred in August. Species of *Culex* and *Culiseta melanura* mosquitoes are implicated as vectors. In addition to the human cases, infections in horses have been reported, five of which were confirmed by isolation of the virus. The disease has also been reported to be present in some flocks of pheasants on breeding farms.

The source and reservoir of infection in the United States are wild and domestic birds. Although serving as hosts, neither horses nor man are important reservoirs of infection for types found in the United States. An infected mosquito is the immediate source of infection for man (except for Russian spring-summer encephalitis which is tick-borne). The incubation period is usually 5 to 15 days. The virus is not directly transmissible from man to man. Susceptibility to the disease is usually highest in infancy and old age; inapparent or undiagnosed infection is more common at other ages. Infection of any degree apparently results in homologous immunity but not to other types.

Preventive measures are directed toward the elimination of known or suspected mosquito vectors through destruction of larvae and adults and their breeding places. Screening of living quarters and the use of individual protective measures, such as repellents and bed nets, are indicated when the disease is present. Vaccines are not recommended for general use.—*Naval Medical Bulletin.*

Joint City-County Sanitary Landfill

A cooperative agreement between Glendale, Calif., and Los Angeles Co. provides for the operation of a city-county landfill, which the county will operate. A charge of $1.25 per ton will be made to the city; of this 75 cents will be used for operation and amortization; the remaining 50 cents will be split between the two governments and will form the basis for financing additional needed equipment. The project contemplates future use of the area for recreational purposes.

Better Service by Remote Controls

Suburban Water Systems which serves a number of communities in Southern California reports better customer service at lower costs is being achieved by the use of telemetering and remote control instruments. This equipment, which makes use of electronic devices and leased telephone company lines, provides a centralized supervisory control over the entire system. In 1957, several functions such as water level in reservoirs, pressures in the system and start-stop buttons for pumping operation were installed on a trial basis for a group of plants in the West Covina area. After a year of trial the very obvious benefits in better control and saving of man power were apparent and it was felt well justified in expanding these controls. In 1958, there were added 10 water level recorders, 9 pressure recorders, 10 start-stop buttons for pumps, and 2 recording flow meters for plants scattered throughout the entire service area some of which are over 25 miles from the office. The signals are transmitted over telephone lines of two telephone companies and pass through seven telephone exchanges and are recorded simultaneously at the company's main office. The control room also serves as the radio communications center where the dispatcher has contact with 31 mobile units equipped with 2-way radios.

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the **MASSEY-FERGUSON**
406 TRACTOR SHOVEL *speaks for itself:*

"HAVE DONE...
CAN DO!"

The Massey-Ferguson 406 can do the same for you — in making a profit and reducing equipment costs — as it has done for others!

Saves time! Speedy *"Instant Reverse"* allows fast in-and-out maneuvering.

Full loads! Handles 1 cu. yd. (SAE rated) with ease because of direct thrust from low pivot points and 9300 lbs. pryout power.

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featuring **INSTANT REVERSE** **with TORQUE CONVERTER**

Go Forward or Back... at a Touch of your Toe!

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Instant Reverse is found only in Massey-Ferguson Industrial Equipment. Just press one foot pedal to go forward . . . switch to another to go reverse. Acceleration is built in each pedal. Has five different speeds — equal in each direction so you can pre-select proper gear range for each job. A demonstration will quickly show you its many advantages.

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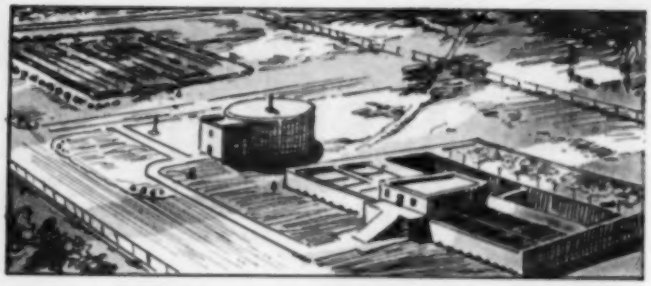


Prepared by **ALVIN R. JACOBSON, Ph.D**

Associate Professor and Head, Division of Sanitary Science, Columbia University School of Public Health

Inlet Baffles

The efficiency of a settling basin is influenced by many factors and the inlet design is certainly an important one. The use of vertical-slotted inlet baffles is one of the newest approaches in seeking ways to improve basin performance through effecting a uniform distribution of flow throughout the vertical cross-section of a settling basin and thus preventing short circuiting. Both of the major studies that have been made previously with this type of inlet were performed with closely spaced narrow slots in model basins, however, the prototype basin inlets were designed with wider slots at greater spacings. Neither of the earlier investigations gave limits on slot spacing, slot width, or velocities through the slot. The purpose of the present study was to obtain detailed information about these items which is needed for design purposes. The study was conducted so that the inlet baffles, basin width, and basin depth could be varied while other basic conditions were held as constant as possible. Phosphates were used as a tracer in obtaining the basic data. However, methylene blue was often used for guidance in determining sampling schedules as well as short-circuiting characteristics. From this important study several conclusions were made of which only a few can be enumerated in this brief digest. The data indicate that: 1) The most effective slot spacings and slot widths for a single slotted inlet baffle are so small that the single baffle has very limited application in sanitary engineering. 2) Tracer recovery data do not indicate that the single vertical-slotted inlet baffle offers much improvement over a submerged inlet behind a simple inlet baffle. 3) A double vertical-slotted inlet baffle has wide application because dimensions for slot spacings and slot widths can be large enough for most sanitary engineering projects. 4) A minimum velocity of 0.1 fps through the first baffle of a double vertical-slotted inlet baffle is satisfactory. 5) Probably the performance of many existing basins can be considerably improved by the inser-

CLEANING SLUDGE BEDS BY MACHINE

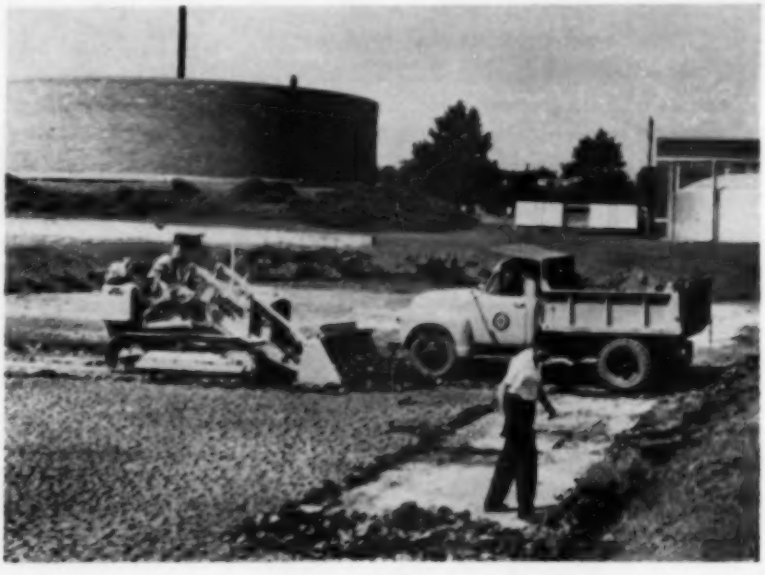
The tines of nine pitchforks have been welded to the side-dumping bucket cutting edge of a Cat Trax-cavator and are to be used to remove sludge from the drying beds of the Springfield, Mo., new sewage treatment plant.

A problem arose during a machine demonstration when attempts were made to remove dried sludge from the beds without excessively disturbing the sand floor. The standard cutting edge of the bucket disturbed the sand too much. Replacing lost sand or re-leveling the floors increased the cost of operation.

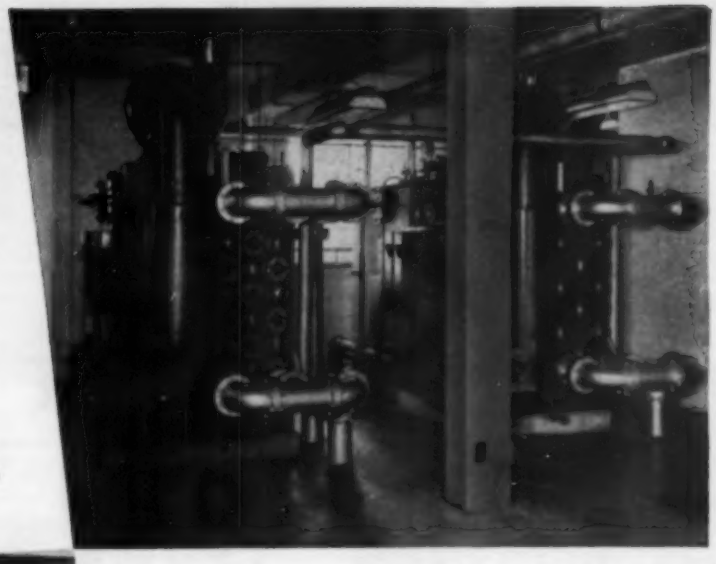
E. A. Martin Machinery Co., Caterpillar dealer, solved the problem by welding the fork teeth to a 1½-yard light materials, side-dump bucket, successfully enabling it to pick up the sludge without damage to or serious loss of sand from the drying bed.

City officials found the side casting ability particularly suitable in this application because it is unnecessary to turn the machine in order to unload material. Turning would damage the sand layer. The only other alternative would be to back out of the sludge bed.

For other miscellaneous jobs around the city, the machine is equipped with a standard 1⅛-yard side dump bucket.



Evansville *Again* Selects P. F. T. Equipment.



ABOVE Efficient and economical digester heating is provided by these two P.F.T. #1000 Heaters and Heat Exchangers.

BELOW P.F.T. 75' Floating Covers are installed on all four digesters.

Progressive, growth-minded Evansville, Indiana, has selected P.F.T. equipment for its *second* sewage treatment plant—the West Side Plant.

The citizens of Evansville are proud of their plant's modern architectural design and the contribution it plays in the Ohio River Restoration Program.

Equally proud is P.F.T. and the part we have played in having equipment in both the East Side Plant and now the new West Side Plant.

P.F.T. equipment includes: Four 75' Floating Covers, two #1000 Digester Heaters and Heat Exchanger Units, four Liquidometer Cover Position Indicators, Supernatant Equipment and Gas Safety Equipment.

We'll be glad to send complete information on any of the equipment used in this installation.

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tion of double vertical-slotted inlet baffles with slot spacings up to 2 ft. —the greater spacing than "ideal" being necessary to obtain a suitable slot width and velocity. 6) A minimum average horizontal velocity of 0.5 fpm appears to be necessary for basin stability. 7) Basin length-to-width and length-to-depth ratios are not determining factors insofar as tracer recovery parameters are concerned as long as the inlet effects a uniform velocity distribution in the basin.

"A Study of Vertical-Slotted Inlet Baffles." By Gordon E. Mau, Sanitary Engineer, Ralph Parsons Co., Dacca, East Pakistan. Paper is based on research for a thesis submitted as a partial fulfillment of the requirements for the degree of Doctor of Philosophy in the Department of Civil Engineering in the Graduate College of the State University of Iowa. June 1958. *Sewage and Industrial Wastes*, December, 1959.

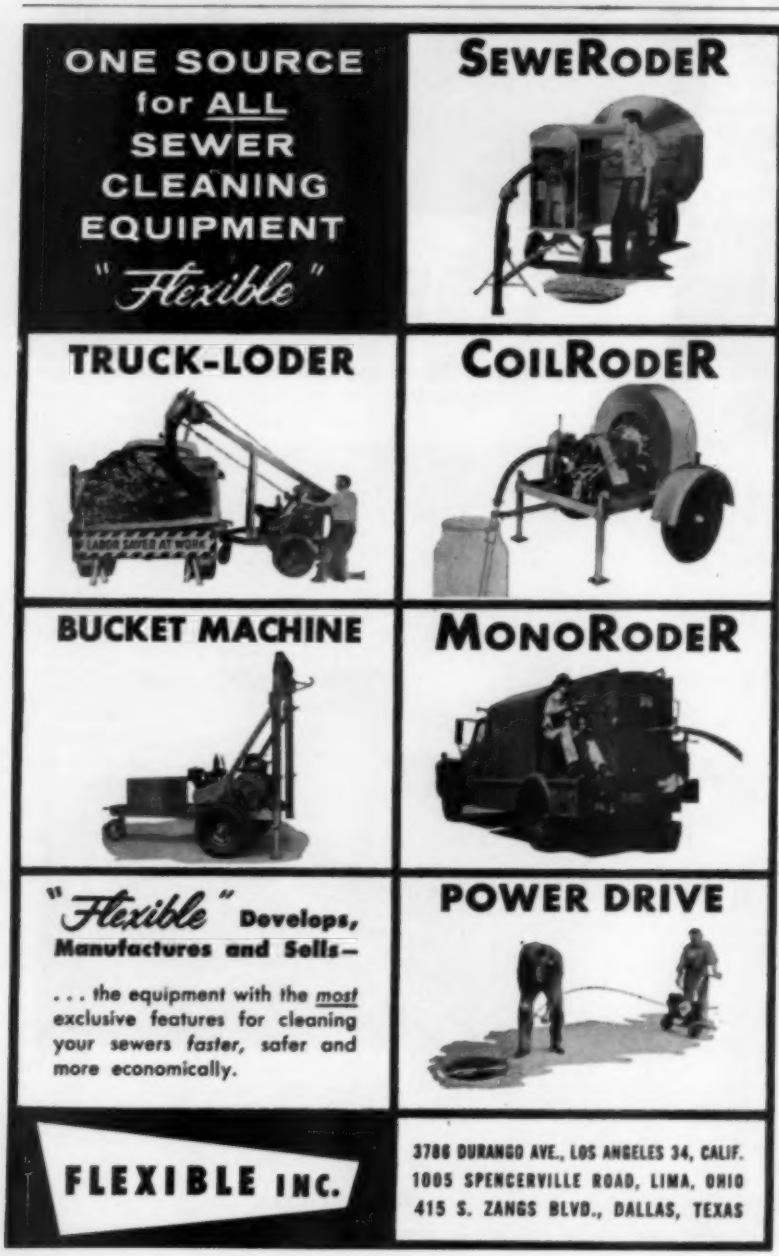
Concentrating Sludge

The Metropolitan Sanitary District of Greater Chicago is interested in the wet-oxidation method (the Zimmerman process) for the ultimate disposal of sludge from its activated sludge plants. In order that this process be self-sustaining, energy-wise, the process requires a sludge feed having a fuel value of approximately 4,000 Btu per gallon. A solids concentration of 5.5 percent to 6.0 percent is needed to obtain the required fuel value per gallon of wet sludge; therefore the present investigation was made to determine the concentrations to which activated and other sludges may be thickened by flotation. Data were obtained to establish a basis for pilot plant design. Pilot plant studies were initiated and are still in progress. Only the laboratory results are reviewed in this article as the pilot plant studies have not progressed sufficiently. The laboratory tests proved that: 1) All sewage plant sludges can be concentrated by dissolved-air flotation. Other test work has shown that even digested sludge may be thickened by this method. 2) The factors affecting the final solids concentration of the thickened sludge include time, character of the sludge and, possibly, the recycle rate. 3) The recycle ratio or rate strongly affects the rate of flotation of the sludge particles within the range studied. 4) An advantage derived from using increasing quantities of recycle is that greater rates of rise of the sludge particles are obtained. The increase in the rate of rise is substantially greater than the increase in total flow, thus, a smaller flotation basin will be required, even though large quantities of recycle are used.

"Concentrating Activated Sludge To a Fuel Value of 4,000 Btu per Gallon." By Dr. Emanuel Hurwitz, Metropolitan Sanitary District of Greater Chicago and Dr. William J. Katz, Research and Development, Chain Belt Company. *Wastes Engineering*, December, 1959.

Trickling Filter Efficiency

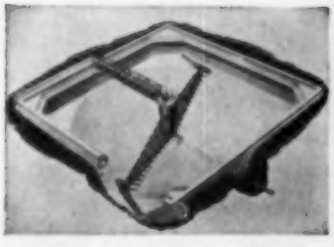
A considerable amount of research relative to all phases of filter design and operation has been done. The study reported here on the most practical filter depth and dosage rate was carried out using a pilot plant trickling filter which was located at the Pullman sewage treatment plant. The experimental unit is divided into two compartments, the control box and the trickling filter, the latter being provided with sampling tubes placed at one-foot intervals. The filter was dosed with effluent from the primary clarifier



PRIMARY AND SECONDARY SETTLING BASINS at O. N. Stevens water filtration plant, Corpus Christi, Texas, are equipped with Link-Belt Series "S" Circuline sludge collectors. This new 48-mgd plant can handle a 50% surge easily, 100% in emergencies.

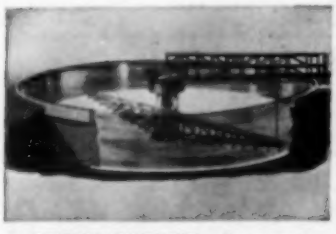
Four series of LINK-BELT Circuline collectors

offer positive sludge removal

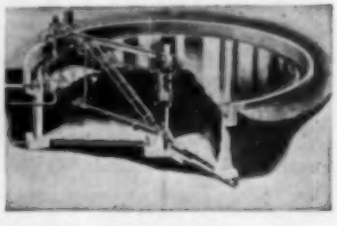


SERIES "S" — specially designed for square and rectangular tanks. As collector revolves, pivoted arms on ends of rakes adjust to thoroughly remove sludge from basin corners.

SERIES "R" — available in models for bottom feed, side feed or cross flow applications . . . in a wide range of sizes. Pitched blades gently convey sludge to center of tank.



SERIES "T" THICKENER — for rugged duty. Similar to "R" collectors except for heavier design. Furnished with fixed rake and automatic or manual lift types.



SERIES "C" — uses simple, positive traction drive to rotate bridge. Slow-speed straightline collector, with long-wearing, corrosion-resistant chains, removes sludge.

There's a design to fit any requirement of tank capacity or construction

THERE's no problem of septicity in settling tanks where Link-Belt Circuline collectors are used. Traveling smoothly and gently, they assure minimum disturbance of flow and the greatest possible concentration and removal of solids in least time.

This efficiency is typical of all the equipment in the complete Link-Belt line for water, sewage and industrial liquids treatment. And it testifies to the value of Link-Belt's more than 35 years' experience in sanitary engineering.

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at the Pullman, Washington, Bio-Filter type sewage treatment plant. The feed consisted of raw settled sewage and recirculated primary filter effluent. During the study the recirculation ratio varied from 1:3 to 1:1.5. The following points summarized are applicable to high rate trickling filters being dosed with treated sewage having a 5-day BOD of 100 ± 20 mg/L of oxygen in the range of 10 to 30 MGAD: 1) The percent reduction of BOD was the same at all the hydraulic loading rates at a specific depth. 2) The BOD reduction in summer is greater than that in winter. 3) There was no change in the relative percent of BOD removal at depths greater than 2 feet during summer. 4) Of the environmental factors affecting filter efficiency, temperature is a major consideration where filter depth does not exceed 6 feet. 5) The highest BOD removal per 1,000 cu. ft. of filter media occurred at the 3-foot depth and with a hydraulic loading of 30 MGAD.

"Research on High Rate Trickling Filter Efficiency." By Samir Azizi Abdul-Rahim, Research Assistant; Ervin Hindin, Assistant Sanitary Chemist; and Gilbert H. Dunstan, Head, Sanitary Engineering Section, Division of Industrial Research, Washington State University, Pullman, Washington. PUBLIC WORKS, January, 1960.

Largest Dano Composting Plant

The City of Duisburg-Huckingen, Germany, with a population of 150,000 persons placed into service in December, 1957, a Dano composting plant for refuse disposal. Composting was chosen as the preferred method, this being considered to have the advantages of lower construction and operating costs as compared with incineration. Also, a very important means of soil improvement for agriculture was considered to exist with the production of compost. Laden refuse trucks dump into receiving bunkers, the raw refuse being transported on apron and belt conveyors to the composting plant. Scrap iron is sorted out by magnetic pulleys, conveyed to a press, and baled. On the final sorting conveyors valuable and brittle materials are picked out by hand, the refuse then being conveyed to the biostabilizers and mixed with sewage sludge from the adjoining treatment plant. Biological decomposition starts with forced aeration and continuous rotation of the biostabilizer drums, converting the refuse-sludge mixture to raw compost within a period of four to five days. After screening, the compost is supplied to agricultural users or stockpiled for later disposal. Screened residues are disposed of by tipping. The main building occupies an area of 114 ft by 69 ft x 42 ft in height. The biostabilizers measure about 84 ft. in length, with a diameter of 11½ ft., and revolve at 0.8 rpm. during the daytime and 0.25 rpm. at night. Two important steps have been taken to alleviate the problem of odors which resulted in complaints from the nearby residences. A system of air circulation has been installed, combined with a two-stage cooler and water scrubber. In addition, an oil-burning flame has been installed through which the exhaust gases are passed. The total cost of the plant was approximately $3,360,000. The working staff totals one foreman and six laborers.

"Dano Composting Plant at Duisburg is the Largest of Its Kind." By A. G. Davies. *Municipal Engineering*, December 4, 1959.

Centrifugal Filtration

To take advantage of gravity flow in the sewerage system, design en-

*THE NAME ORANGEBURG AND THE SILVER BAND ARE REGISTERED TRADE-MARKS OF THE ORANGEBURG MANUFACTURING CO.

Over 300 million feet in use coast to coast!

The test of time has proved the high quality of Orangeburg *Root-Proof* Pipe and Fittings for house sewer lines, downspout run-offs and other underground, non-pressure uses.

Orangeburg's Taperweld Joints seal root-proof and watertight. No leakage, no infiltration. And because it's made of a strong, tough non-metallic material, Orangeburg does not rust. Alternate freezing and thawing... acids and alkalies found in ground water and sewage do not affect it.

All these qualities plus speed, ease and economy of installation have gained for Orangeburg a growing acceptance among leading approving authorities, architects, engineers, builders and plumbers. Today, over 300 million feet of Orangeburg are in service from Maine to California.

The Silver Band* identifies *genuine* Orangeburg: *Root-Proof* Pipe for sewer lines; *Perforated* Pipe for foundation drains, septic tank disposal fields. Orangeburg exceeds requirements Federal Spec. SS-P-356 and Commercial Standard CS 116-54. Write Dept. PW-20 for Engineer's independent report.

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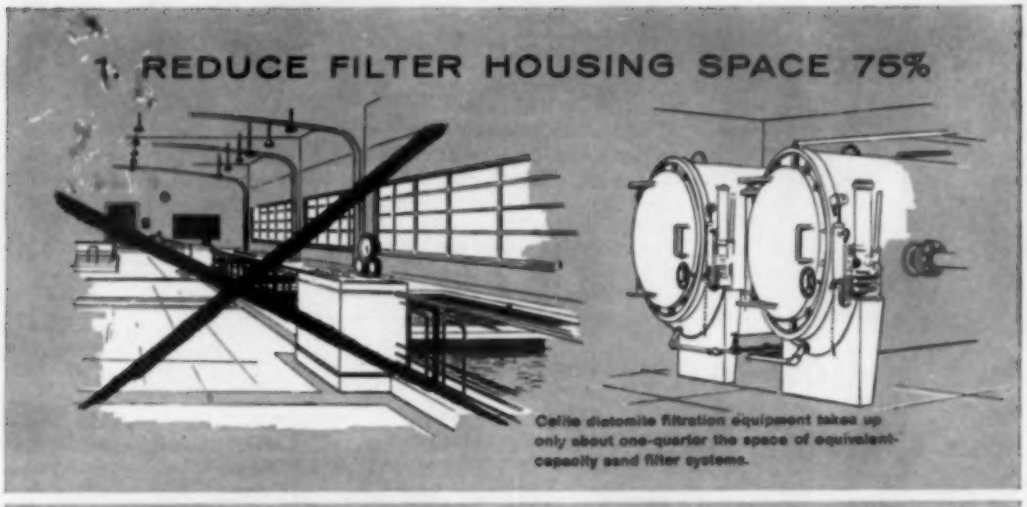
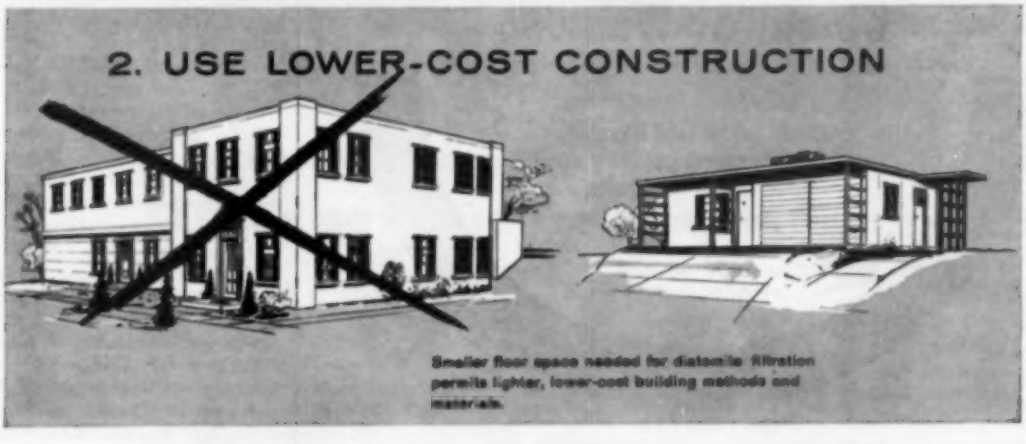

1. REDUCE FILTER HOUSING SPACE 75%
Celite diatomite filtration equipment takes up only about one-quarter the space of equivalent-capacity sand filter systems.


2. USE LOWER-COST CONSTRUCTION
Smaller floor space needed for diatomite filtration permits lighter, lower-cost building methods and materials.

You save filtration construction dollars these 2 ways with Celite diatomite

One installation after another proves you need about 75% less filter housing space for equivalent capacity when you use diatomite filtration with Johns-Manville Celite*.

Also, diatomite's lighter, smaller equipment permits you to use lower cost building methods and materials. For example, a simple concrete slab with light framing and siding instead of a large reinforced concrete-and-brick building with built-in concrete filters†.

Diatomite filter equipment is so compact because it provides a much larger filter surface in proportion to size of equipment. In many cases, raw water can be filtered directly—pretreatment facilities can be eliminated. For Celite removes more suspended solids, including amoebae and algae, and turbidity is usually much lower.

Mined by Johns-Manville from the world's largest and purest commercial diatomite deposit, Celite is carefully processed for purity and uniformity. It is available in a wide range of grades for best practical balance of clarity and flow rate with any suitable filter. For further information, see your nearby Celite engineer. For free technical reprints and illustrated brochure, write to Johns-Manville, Box 14, N.Y. 16, N.Y. In Canada, Port Credit, Ont.

JM

*Celite is Johns-Manville's registered trade mark for its diatomaceous silica products.

†*See Comparison Studies of Diatomite and Sand Filtration* by G. R. Bell, Journal American Water Works Association, September, 1956 or write for free reprint.

JOHNS-MANVILLE

gineers and city officials selected a site in a residential district to construct a sewage treatment plant. This North San Mateo County Sanitation District sewage treatment plant is located in Daly City, Calif., adjacent to Westlake Recreation Park. Sludge drying beds for dewatering digested sludge were unthinkable from an esthetic viewpoint as well as capital costs. After careful study, the consulting engineers selected an 18 by 28-inch Bird continuous centrifugal filter for dewatering digested sludge. This type filter takes up a minimum amount of space and requires no chemical pre-treatment, thus eliminating the necessity for chemical storage and handling facilities, feeders, mixers and flocculating tanks. Sludge is pumped directly from the digester to the centrifuge at a rate of 15 gpm. The digested sludge concentration generally contains 7-8 percent solids and the dewatered sludge from the centrifuge averages 30-35 percent solids by weight. This is collected on a belt conveyor which delivers it to a truck for disposal on the grounds or city recreation parks; also, it is available to city residents for their flowers and lawns. The centrifuge effluent has always been returned to the primary sedimentation basins. The centrifuge at present is operated approximately 10 hours per week over a three-day period and has proven extremely reliable, requiring a minimum of operator attention, and only a nominal amount of maintenance.

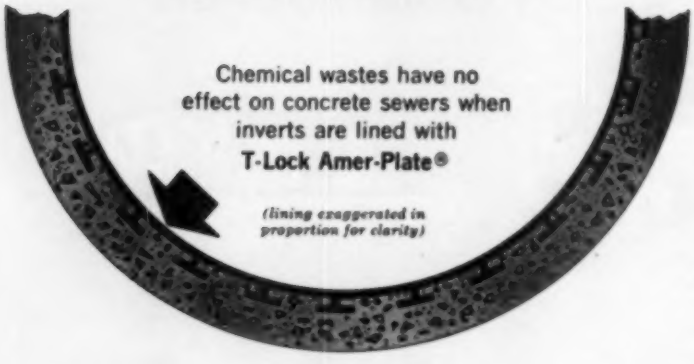
"Centrifugal Filtration of Digested Sludge." By William F. White, Sales Engr., Bird Machine Co. *Water & Sewage Works*, December, 1959.

Toledo Keeps $9.5 Million Promise

New and unusual secondary-treatment facilities at Toledo, Ohio, costing approximately $9,500,000 will help considerably to provide the means of cleaning up the Maumee River and the Bay Area. The treatment plant now provides high-rate pre-aeration, pre-chlorination, grit removal and nitrification, as well as aeration of primary effluents and final settling. Its present flows average about 50,000,000 gallons per day, but the plant is designed for secondary treatment of up to 70,000,000 gallons. Raw sewage enters the plant through a lift station to allow gravity flow through all treatment phases. The sewage then flows through coarse screens to a pre-chlorination point and detritor building. The grit-free sewage flows to pre-aeration units, where compressed air is introduced and separation and skimming of greases and collection of sludge is provided. Primary settling is provided for in eight settling tanks, each equipped with Dorr traction sludge collecting mechanisms. The settled sludge is pumped to eight digesters provided with fixed covers and Dorr stirring equipment. A long connecting channel directs the settled sewage to the aeration tank, where it is mixed with returned activated sludge for the destruction and stabilization of organic materials. Following aeration of primary effluent, the mixed liquor flows to final settling tanks from which the final effluent is discharged to the river. The digested sludge is pumped to 3¾ acres of glass-covered drying beds, then pulverized, bagged and sold as soil conditioner. At present, the soil conditioner handling facilities which consist of a Gruendler Pulverizer and St. Regis Paper Company automatic bagging machines, are leased out to a private contractor for operation under the control of the city.

Toledo Keeps $9,500,000 Promise." By Elmer Pollex, Superintendent of Sewage Treatment. *The American City*, December, 1959.

How to Protect Concrete Sewers from Chemical Wastes


Chemical wastes have no effect on concrete sewers when inverts are lined with
T-Lock Amer-Plate®
(lining exaggerated in proportion for clarity)

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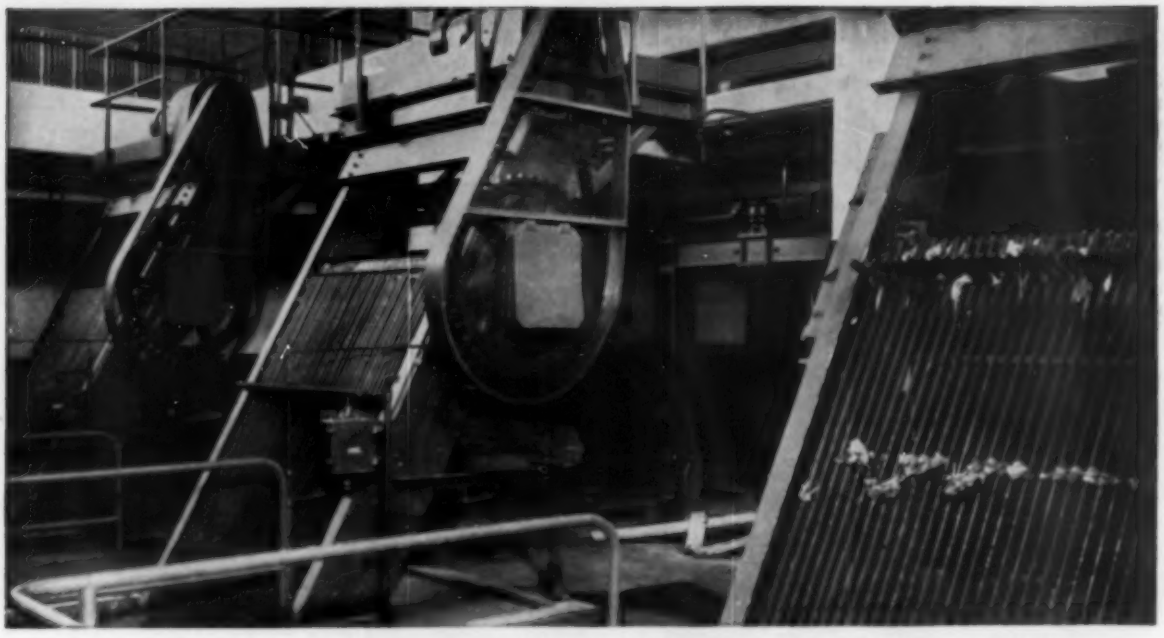

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Confidence in the efficiency and reliability of Jeffrey sewage treatment equipment resulted in its use in the original 40 mgd Bowery Bay Plant... when the World's Fair triggered New York City's long range attack on harbor pollution. Selection of Jeffrey Bar Screens and Collectors for the recent big extension of plant capacity (now 120 mgd) testifies to the performance record of the 18-year-old Jeffrey equipment.

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Other Articles

"Structural Design of **Clay Pipe Sewers.**" How to compute the loads placed on pipe in trenches and to design for structural safety. By John B. Powers, Engineering Representative. W. S. Dickey Clay Mfg. Co. Public Works, January, 1960.

"Use of Completed **Sanitary Landfill Sites.**" Potential hazards involved and special construction requirements for buildings erected on sanitary landfill sites. By C. A. Rogus, Director of Engineering, Department of Sanitation, New York City. Public Works, January.

"**Aquatic Life** in a New Stream." A report on the types, and time intervals required to establish aquatic life in a stream. By Ruth Patrick, Dept. of Limnology, Philadelphia Academy of Natural Sciences. Water & Sewage Works, December, 1959.

"Warren, Mich. Solves its **Sewerage Problems**" by constructing a sewage treatment plant with flexible sludge-disposal facilities. By R. L. Braithwaite, Sanitary Engineer, Johnson & Anderson, Inc., Consulting Engineers, Pontiac, Mich. The American City, December, 1959.

"Removal of **Pathogenic Microorganisms** by Sewage Treatment Processes." Sewage treatment effluents will contain a portion of all organisms present in the untreated sewage, and the accumulated solids will show higher concentrations of microorganisms than the liquid portion. By Paul Kabler, Chief of Microbiology, Robert A. Taft Sanitary Engineering Center, Public Health Service, Cincinnati, Ohio. Sewage and Industrial Wastes, December.

"Physical and Chemical Behavior of **Suspended Solids.**" An exploration of some of the things known about one species of stream pollutants—suspended solids. By Richard D. Hoak, Mellon Institute, Pittsburgh, Pa. Sewage and Industrial Wastes, December, 1959.

• • •

Improved Sewage Treatment for Alliance

To comply with treatment standards of the Ohio Department of Health and also to enlarge facilities to handle sewage from area sewer districts, plans for modernizing and enlarging the Alliance, Ohio, sewage treatment plant were developed by Floyd G. Browne and Associates, consulting Sanitary Engineers. Based on projected growth of the area the facilities were designed for the year 1975. Bids on the project were received in October, 1958, and the contract awarded the lowest of 12 bidders, Midwest Construction Company of Cleveland. All equipment and materials have been ordered and actual construction is expected to begin in the spring of 1960.

The project will include a new diversion chamber at the head of the plant, piping to the new primary tanks and to the filters, including 1,600 feet of 24 to 42 in. reinforced concrete pipe, and a new screen chamber with two 10-mgd Worthington Comminutors. Air lift pumping units will be installed in conjunction with new preaeration and grit removal tanks, equipment and building and new primary settling tanks with skimming and sludge collection. These will handle 11.7 mgd.

New sewage flow and sludge meters will be installed. Pumps and piping installation at the trickling filters will provide for recirculation of the filter effluent. A new 65-foot diameter fixed cover digester with an enlarged control building and additional Dorr heat exchanger will be built.

The present screen building will be remodeled to house a Komline-Sanderson coil sludge filter and a new sludge holding tank will be constructed. A Cyclone fence will be built around the Imhoff tanks which will not presently be used, and existing gravel roads will be black-topped. Total cost of the project is estimated at $696,700.

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The growth of American industry and agriculture, the rise in standard of living, war-caused shortages of materials, the high cost of economic inflation, all have combined with public indifference to create a 30-year-period of delay in water works improvements . . . a situation now serious, and which could become tragic.

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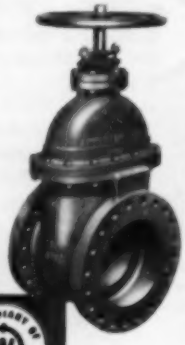
This Series is an attempt to put into words some appreciation of the water works men of the United States.



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Report Covers First Year's Operations of County Sewage Disposal Facilities

TREATMENT facilities of the Middlesex County Sewerage Authority, which serves several communities and a number of industries along the Raritan River in New Jersey, are designed to have an ultimate capacity of 78 mgd for average flows and will be able to handle peaks up to 115 mgd. At the start of operations the planned capacity of the plant is 52 mgd.

Considerable data on the organization of the Authority and results of the first year of operation of the treatment plant have been covered in an excellent annual report. Details of the operational flow at the plant, metering and sampling by participants and the program for chlorination control were reviewed in the December, 1959, issue of PUBLIC WORKS. Further information on the plant is given below.

Treatment Details

After grit is removed from the sewage at the grit chambers, the sewage flows through an 84-inch by 37.9-inch venturi tube in the main building, and continues to the distribution chamber through an 84-inch reinforced concrete pipe, where it is allowed to flow into 4 flocculation-clarifier tanks in parallel through 42-inch reinforced concrete pipes. Chlorinated copperas is fed at this point, and the sewage is continually tested for pH which is used as one of the factors in the control of the lime feed. The area of the distribution chamber is 330 square feet, the average water depth is 18 feet, and the detention time at 52 mgd is 1.2 minutes. Three flash mixers, having a total propeller capacity of 6,500 cubic feet per minute, are also located here.

There are 4 flocculation-clarifier tanks. The flocculation units are 55 feet in diameter, have an average water depth of 10.25 feet, a capacity of 24,400 cubic feet, and a detention time of 20 minutes at 52 mgd. The clarifier portions are 130 feet in diameter with an average water depth of 12.5 feet; a capacity of 153,000 cubic feet; a surface area of 10,900 square feet; a surface loading of 1,190 gallons per square feet per day; a weir length of 408 feet; a weir rate of 31,800 gallons per linear foot per day; and a detention time of 2.1 hours at 52 million gallons per day. Sludge drawoff is normally accomplished by telescoping sludge valves, adjustable pipes which allow light sludge (about 0.5% solids) to flow by gravity to a sludge well in pumping station No. 1 (main pumping station). The clarifier effluent flows directly to the post-chlorination chamber where chlorine solution is applied. Since the 84-in. outfall pipe is 17,000 feet long, the time contact after chlorination even for 115 million gallons per day, is 62 minutes.

Normally, 300,000 cubic feet of light sludge are drawn from the flocculator-clarifier tanks in one day. This sludge is pumped to the sludge thickening tanks by means of one of 5 centrifugal sludge pumps from the sludge well of this station. A dewatering pump with a capacity of 1,700 gallons per minute is used to dewater the flocculation-clarifier tanks whenever necessary. Whenever this is done, however, the ground water table under and around the Flocculator - Clarifier tanks must be appreciably lowered, or else the hydrostatic pressure would cause the concrete bottom of these tanks to lift and crack. Crushed stone has been used as a base under these large tanks; encased in this crushed stone is an interlocking of 12-inch perforated asbestos - lined, bituminous - coated, corrugated metal pipe, draining into a common header and subsequently into a deep manhole. A pump is inserted into this manhole prior to dewatering the tanks, and the ground water table is thus lowered.

Also located at this station is the reservoir for all the process water used throughout the plant. Two systems are alternated to keep the well full. Each system includes an effluent pump capable of pumping 2,500 gallons of clarifier effluent per minute through a stainless steel screen with a mesh of 40. Each system also has one spray water pump which supplies sufficient water to keep each screen clean. A connection from the post-chlorination feed system enables a small amount of chlorine solution to be fed to the process water to keep the process water relatively free of scum. Two small sealing water pumps, used alternately, are used to supply various pumps which have water-sealed stuffing boxes, and to purge the instrument lines on two sludge venturi tubes. Two process water pumps are used to furnish water to the flocculation-clarifier tanks, the 3 pumping stations, and the sludge storage tanks for washdown operations. It should be noted that approximately 2.5 million gallons of process water are used throughout the plant every day.

Two sludge thickening tanks are used alternately to thicken the light sludge pumped from the flocculation-clarifier tanks from 0.5 percent to about 6.5 percent solids. Each tank has a diameter of 80 feet, an average water depth of 16 feet, a capacity of 80,200 cubic feet, and detention times of 4 hours for supernatant, and 12 hours for sludge. The effluent from this tank flows back to the distribution chamber where it is recirculated through the flocculation-clarifier tanks.

Four sludge storage tanks, each with a diameter of 80 feet, an average water depth of 21 feet, and a capacity of 105,000 cubic feet (3,400 tons) are used to store the sludge pumped from the thickening tanks and the grit from the grit chambers. Each tank is equipped with 3 levels of recirculation, and a nozzle to wash down each tank during disposal of the sludge.

Four vertical sludge pumps with a discharge capacity of 4,150 gallons per minute are used to recirculate the sludge within one tank at different levels, to transfer sludge from one tank to another, or to pump the sludge from a storage tank to the barge at the dock, 2200 feet distant from this pumping station. Sludge is pumped to the barge on the average of once per week and at the average rate of 1,000 tons per hour. One barge load constitutes approximately 3,300 tons. It is of interest to note that all of the most frequently used valves in this pumping station are pneumatically operated plug valves.

The average flow from May to December was 35.19 mgd. The eight monthly averages shown do not deviate widely from this figure, although individual days following heavy or prolonged rains show flows greatly in excess of normal. These increased flows are accounted for in the metered flow from the participants, indicating that the infiltration occurs almost entirely in some of the older municipal collecting systems now tied into the trunk sewer.

The hour-to-hour flow variation is much less than at most plants, the daily maximum and minimum deviating from the average ordinarily by about 15 percent. Also, the high and low flows form broad plateaus on the chart rather than sharp

peaks. The minimum flow is usually centered near the hour of 8 am, and maximum flows most frequently occur in the late afternoon. Several reasons account for these differences from the flow pattern observed at most plants. The great length of the system means that peak flows from various parts of the area served do not arrive simultaneously. Also, the trunk system, with its large diameter and length, much of it with relatively flat slopes, tends to equalize flows between peak and minimal. About half the flow is industrial, and does not follow the usual domestic pattern. In fact, several large industrial participants contribute essentially constant flows around the clock. Finally, the Sayreville pumping station does much to equalize the flow.

The average chlorine feed over the 8-month period was 55 mg/L, requiring 15,900 pounds of chlorine per day. Variations of chlorine demand from day to day, and even from hour to hour, are extremely wide and sometimes quite sudden, so that control of the chlorination requires more attention, checking, and adjustment than is necessary in the great majority of plants.

BOD and SS Removals

The average BOD removal was 14 percent, with figures for the individual months ranging from 12 to 17 percent. An unusually large proportion of the BOD in the combined flow is in the soluble fraction, owing to its origin in the various industrial contributions to the system. The plant was designed on this basis, and high BOD removals were never anticipated. Pre-design studies indicated that the receiving water, Raritan Bay, was capable of absorbing the anticipated BOD load with improvement of its quality. Although the period of operation is not yet considered long enough to permit a final conclusion, the data thus far accumulated from bay samples appear to support the basis of the plant design.

The removal of suspended solids has uniformly exceeded the requirements of the regulatory agencies, which specify 60 percent reduction. Correspondingly, a consistently high degree of removal of settleable solids has also been realized.

The average quantity of sludge barged to sea was 15,252 wet tons per month, with an average concentration of 4.7 percent solids. There is some decrease of solids concentration during storage, due to partial decomposition of the solids.

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THE
INDUSTRIAL WASTE DIGEST

Prepared by **CLAYTON H. BILLINGS,** *Associate Editor*

Lagoon Oxidation Of Spent Sulfite Liquor

Lagooning spent sulfite liquor is usually not practiced for the sole purpose of biological oxidation of the waste, yet if it could be adapted as a method of treatment it is a potentially economical solution to a difficult waste disposal problem. A study was undertaken of the role of algae in assimilating carbohydrates present in the waste and in using them as carbon and energy sources for growth in the dark. A pure culture of a green alga, *Chlorococcum macrostigmatum* Starr, was grown in a basal medium containing calcium nitrate, potassium hydrogen phosphate, magnesium sulfate, sodium silicate, ferric citrate and citric acid. The waste source was a calcium base sulfite liquor concentrated to 57 percent solids. Algae growth, judged by variations in numbers and dry weight of cells produced, was observed when the system was inoculated with the sulfite liquor concentrate. The basal medium, both with and without the spent sulfite liquor was found to support good growth of the alga. There was a slight decrease in cell numbers when the alga was grown in the light, but it appears that the lag phase of growth was shortened, reducing the duration of the entire growth cycle. The production of a greater dry weight of cells in the presence of spent sulfite liquor than in its absence suggests that available nitrogen was consumed faster when the waste was present. The spent sulfite liquor was able to support growth in the dark. Although cell counts were higher in the light than in the dark, there was little difference in the cell dry weights of the two. This indicates that the waste can serve as a source of energy and that the alga can assimilate carbohydrates in spent sulfite liquor independently of photosynthesis. It was also found that the amount of nitrogen present affected assimilation of sugars by alga.

"Utilization of Sugars in Spent Sulfite Liquor by a Green Alga, *Chlorococcum Macrostigmatum*." By Thomas E. Maloney, Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio. *Sewage and Industrial Wastes*, December, 1959.

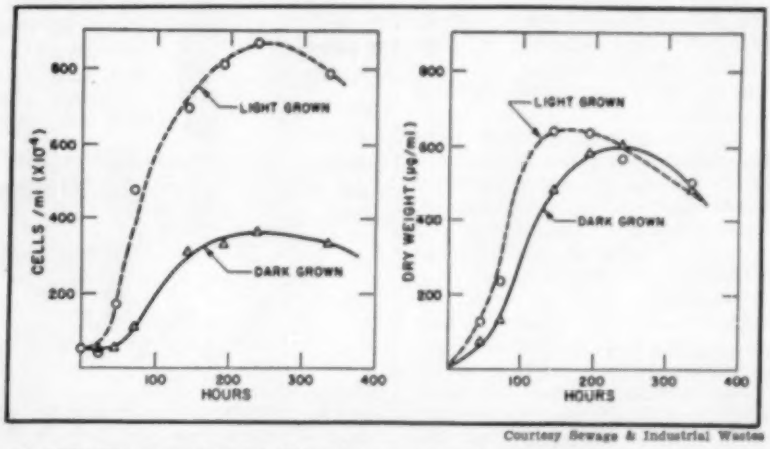
Radioactivity in Sea Water

Although radionuclide analysis is required for complete evaluation of contamination of natural waters by radioactive wastes, a screening method for determining gross radioactivity would be of considerable value. Evaporation procedures for the latter purpose are limited to small volumes, so that when radioactive levels are low and large samples (100 to 250 ml) must be used, carbonate precipitation of the ions has been employed. With samples one liter and larger, where the salt content is high, precipitation as sulfides of most of the isotopes of interest can be accomplished in an ammoniacal solution. The sulfide precipitate is separated and counted to provide a screening technique for gross radioactivity. Alkali, alkaline earth and arsenic - antimony - tin groups remain in the mother liquor and may be recovered from the filtrate by precipitation with sodium carbonate. Cesium can be recovered from the filtrate of the latter step. The sulfide precipitate contains more than 95 percent of the activity due to the rare earths, ruthenium, chromium, zinc, cobalt and similar metals. The alkaline-earth precipitate contains 90 percent of the strontium and presumably a similar amount of the barium-radium. The cesium precipitate contains about 95 percent of the cesium present.

"Determination of Radioactivity in Saline Waters." By Vincent J. Sodd, Abraham S. Goldin and Richard J. Velten, Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio. *Analytical Chemistry*, January, 1960.

Pulp and Paper Mill Waste Treatment

The new approaches in research on pulp and paper mill effluent



Courtesy Sewage & Industrial Wastes

● **GROWTH comparison of Chlorococcum macrostigmatum in light and in dark.**

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treatment are related to three basic problems: Dewatering and disposal of sludge from clarification processes, reducing color in bleaching wastes and removing BOD. Two new centrifuges, the vertical disc and horizontal conveyor types, have shown results in laboratory trials of sludge dewatering sufficiently encouraging to interest a number of mills in running tests with full-scale equipment. Experiments on the combined handling of fly ash and sludge on vacuum filters have shown promise. Heretofore, aerobic digestion at ordinary temperatures has not been applicable to paper mill sludge because it has not been possible to obtain the sludge in a sufficient dry state. Recently a pilot aerobic digester has been built to operate in the temperature range of growth of thermophilic bacteria. It utilizes recirculation of sludge through a reactor at a high rate in the presence of compressed air. It appears possible to obtain rather rapid destruction of organic matter with the unit. Studies on reducing the color of kraft pulping and bleaching effluents by means of lime have recently developed a method of almost complete color removal by vacuum filtration of kraft bleaching caustic extract through a bed of hydrated lime. In another development it has been found that using chlorine dioxide instead of caustic in the bleaching process eliminates the caustic extraction stage and with it much of the color. Studies on BOD removal from effluents have centered around aeration of stabilization basins. Results to date show that aeration and recycling of effluents in the basins greatly improves oxygen transfer and hastens stabilization time. There now appears to be available an oxidation process for good BOD removal from effluents at lower costs than present systems, depending on the existence of sufficient land area and the possibility of odor control.

"New Approaches to Pulp and Paper Mill Waste Treatment." By Harry W. Gehm, Technical Advisor, National Council for Stream Improvement, New York, N. Y. *Industrial Wastes*, December, 1959.

Cement Plant Dust Problems

In a typical cement plant several thousand tons per day of rock are pulverized to a fineness such that 90 percent pass a screen having 40,000 openings per sq. in. This material is processed in rotary kilns at temperatures of 2700 to 3000°F, in the presence of air passing through

the kilns at high velocities. The clinker produced in the kilns is finely ground to make cement. The handling of the powdery materials produces dust problems difficult to control. The Lehigh Portland Cement Co. in Metaline Falls, Washington, built their plant in 1910 in a wilderness. Eventually a town grew up around it and the area was further spurred into population growth by industrial expansion of the community. During plant expansion in 1948 when the air pollution problem had reached appreciable proportions, a Buell cyclone collector was installed on a new kiln to remove dust from discharged air. This effort plus discharge through a high stack was expected to minimize air pollution to an acceptable level. However, the problem persisted during humid days and nights. Consequently, a Cotrell electrostatic precipitator was installed in series with the Buell unit. To serve the other kilns, Western Precipitation Multicones were installed. These together with blowers to keep the plant dust-free, a Roctoclone precipitator at the raw crushing plant and various other dust collecting apparatus have cost the firm over a half million dollars. A full-time attendant for the equipment is employed and the operation is logged daily. Sometimes the dust collected by the electrostatic precipitator can be returned to the process, but most of the time it must be discarded because of the high alkali content.

"Dust Control in Cement Manufacturing." By A. W. Schaeffer, Manager, Lehigh Portland Cement Co. *Industrial Wastes*, December, 1959.

Lake Pollution Monitoring with Charts

Ownership of a large tract of land on Lake Ontario afforded Canadian Industries Limited the opportunity to establish base lines for an effective pollution control program before the area becomes highly developed. In 1956, when the study was initiated, the only plant operating at the Millhaven, Ont., site was one manufacturing synthetic textile fibers, having a waste consisting principally of cooling water. As a precaution against anticipated future industrial development of the area, the feasibility of a pollution monitoring program was studied. It was decided to establish sampling stations in Lake Ontario along three concentric rings at distances of 100 yds., 1/3 mile and one mile from the outfall. In the interest of detecting pollution well before the prob-

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lem stage, the monitoring program was directed toward observing changes in populations of invertebrate fauna in bottom samples. Samples were taken from a boat with a Peterson dredge, designed to remove one square foot of mud; samples were passed through a 30-mesh sieve to extract the animal forms. The fauna were classified into chironomids, snails, bivalve mollusks and oligochaete worms and the numbers of each were noted. After sufficient data were collected, control limits were established with respect to anticipated population fluctuation due to natural causes. Further statistical analysis provided a means of charting the sampling data. Bivariate charts were constructed using the number of animals found at two different sampling stations as x and y coordinates. The 95 and 99 percent confidence limits (limits which should not be exceeded 95 and 99 percent of the time) were superimposed on the charts. In application, subsequent sampling data are plotted and should any points fall outside the 95 or 99 percent control limit, possible pollution is indicated. Experience with the use of the charts showed the method to be very sensitive in detecting an adverse situation long before other signs of pollution would be evident.

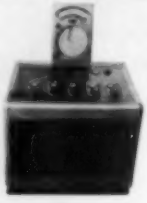
"Pollution Monitoring and Prevention by Use of Bivariate Control Charts." By T. W. Beak, C. de Courval and N. E. Cooke; respectively, Consulting Biologist, Kingston, Ont., Mathematical Statistician and Chemical Specialist, Canadian Industries Limited, Montreal, Que. *Sewage and Industrial Wastes*, December, 1959.

Industry and Community Cooperation

The design solutions for the treatment of difficult industrial wastes at five projects handled by Bowe, Albertson and Associates are reviewed. All involve collaboration with municipalities to determine whether combined or separate treatment would be employed. At Wallingford, Conn., where waste from a metal working industry forced construction of a new sewage treatment plant, it was decided to convey all industrial wastes through separate sewers to the municipal plant site for separate pretreatment for removal of toxic components. This will involve addition of lime to precipitate heavy metals at a pH of 9, followed by alkaline chlorination to assure destruction of the cyanide. After settling and storage in lagoons the effluent will be combined with domestic sewage effluent.

A similar arrangement was effected at Stratford, Conn., where it was believed that hexavalent chromium and cyanides from an aircraft industry would be too much for domestic treatment units. A common site was selected for both plants to be operated by the same personnel.

At Port Chester, N. Y., the troublesome wastes included pickling liquor from a bolt works; intermittent discharges of dye wastes; batches of spent activated carbon from a candy plant; cyanide wastes from plating; and soluble oil, grease and rags from a laundry. The pickling liquor was pretreated; separated disposal was arranged for spent cyanides; soluble oil was cracked and the oil sold; and a holding plant was installed at the dye plant for equalization of discharge to the sewer system. The new sewage treatment plant will provide comminutors to handle the rags and mechanically cleaned settling tanks to assure removal of carbon, with sludge and scum filtered without digestion and disposed of as landfill. Pilot plant tests indicated that iron in the pickling rinses will help remove more than 70 percent of the



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suspended matter in the mixed flow.

At Branford, Conn., the activated sludge process was chosen for treatment of domestic sewage. The industrial wastes included zinc and iron. It has not been decided whether pretreatment will be used with precipitation of the heavy metals and dewatering of the sludge at the municipal plant, or whether a separate waste treatment plant will be installed.

Consideration was given to combined sewage and waste treatment at Lee, Mass., where the industry concerned is a paper mill. It was concluded that the white water, which will be six times the domestic sewage flow, cannot be handled in the sewer system or municipal plant. However, it is believed that the cooker liquor, if equalization of flow is provided, can be oxidized by high rate filters planned for future construction at the municipal plant.

"Municipalities Should Handle Amenable Industrial Wastes." By John G. Albertson, Bowe, Albertson and Associates, Consulting Engineers, New York, N. Y. *Wastes Engineering*, December, 1959.

Other Articles

"Thermal Discharges." By R. H. Laberge, School of Public Health, University of Michigan. Heated waste effluents can become a problem of stream pollution by affecting oxygen balance and the production of synergestic action in the presence of toxic chemicals. Water and Sewage Works, December, 1959.

"Industries Recover Valuable Water and By-Products from Their Wastes." By Edmund B. Besselievre, Manager, Industrial Wastes Division Kaighin and Hughes, Inc. Increasing emphasis is being given by industry to the recovery of valuable components as a means of reducing the cost of treatment, if for no other reason. Wastes Engineering, December, 1959.

"Nature of **Air Pollution.**" By Lyman A. Ripperton, School of Public Health, University of North Carolina. The author reviews all aspects of the urban air pollution problem. Industrial Wastes, December, 1959.

"Physical and Chemical **Behavior of Suspended Solids.**" By Richard D. Hoak, Mellon Institute, Pittsburgh, Pa. The findings to date suggest that presently held theories of sedimentation are not suitable for predicting the behavior of suspended solids in natural streams. Sewage and Industrial Wastes, December, 1959.

Unaccounted-For Water

In Mt. Vernon, N. Y., 1958 water consumption amounted to 96 gpcd. Unaccounted for water represented 13.7 percent of the total water purchased; in 1957, unaccounted-for water was 11.7 percent.

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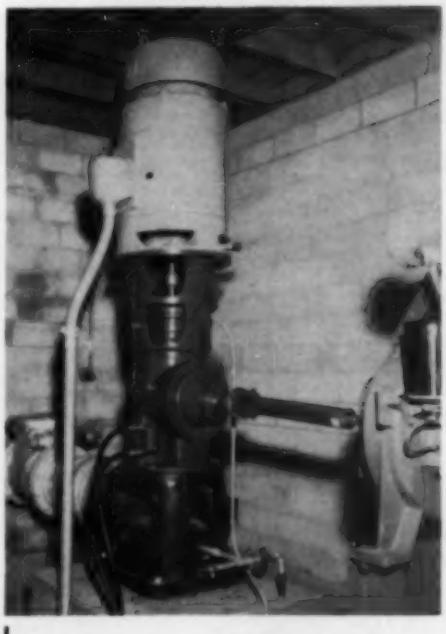

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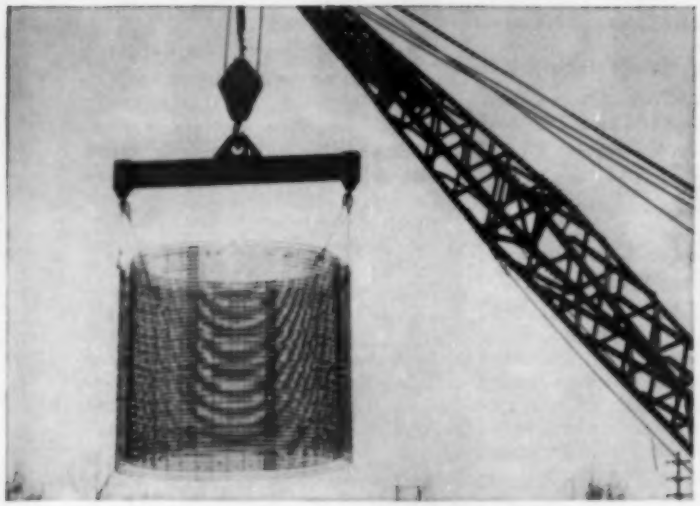
The contractor was able to lay 15 to 20 sections of 8-foot pipe in 8-hour work shifts. This rapid progression indicates the exactness of the sections of concrete pipe furnished to the job. The contractor used care in keeping the trench walls vertical and narrow. Since the load-bearing capacity of the pipe is greatly influenced by the width of the trench, this type of installation is desirable and can be accomplished without special labor or equipment.

Visintine & Company and The Complete General Construction Co., Columbus, Ohio—Contractors

Price Brothers, Columbus, Ohio—Pipe Manufacturers

40-foot depth on Ohio Interstate Highway



The 2 cages of American Welded Wire Fabric are tied together at both the top and bottom with ⅝" diameter stirrups. These stirrups increase the ultimate strength of the pipe and resist diagonal tension at top and bottom sections. If the circumferential steel were not accurately spaced, it would be difficult to place the stirrups in the positions required for best performance. This consideration, plus the over-all economy of using readily fabricated American Welded Wire Fabric, led to its selection.

Over-all view of the trench digging and pipe laying operations. You will notice that the 40-foot trench is open cut using a dragline down to the first level and then a back hoe to the 40-foot level. This sequence of operations enabled the trenching operation to proceed very rapidly. The back hoe digging the final trench provided the extremely straight and narrow trench for best installation.

In Columbus, Ohio, work is progressing on one leg of the important new North-South Freeway. 96" dia. reinforced concrete pipe was specified for a 40-foot depth installation. This was included in one of the largest contracts ever let by the state of Ohio.

The state of Ohio special specifications were followed and each phase of the pipe manufacture and installation was inspected by representatives of the state. The pipe was required to withstand 24,000# per ft. for the 0.01" crack, and 32,000# per ft. for the ultimate strength. The actual three-edge bearing test results showed the pipe passed these requirements with flying colors. The 0.01" crack did not appear until 26,000# per ft., and the ultimate was not reached until the load reached 39,200# per ft.

Produced by Price Brothers, Columbus, Ohio, the 8-foot sections of pipe with an 8½" wall of 5,000-lb. concrete, were constructed with two reinforcing cages of USS American Welded Wire Fabric. The outside cage is style 2" x 8"—0.4375" x 5 gauge and the inside cage is style 2" x 8"—0.505" x 5 gauge. More than 400 stirrups were positioned between the fabric cages for each 8-foot section to increase the resistance to diagonal tension and improve the pipe's ultimate strength.

The production of concrete pipe is closely controlled and numerous tests are conducted to assure design strength. High quality reinforcing steel is an essential ingredient for top-quality pipe. That is why USS American Welded Wire Fabric was chosen to reinforce the concrete pipe for this job. It is machine-made by electrically welding high tensile strength steel wires made to exacting specifications. The guaranteed minimum yield point is 60,000 psi and the guaranteed ultimate strength is 75,000 psi. All members are spaced to the close tolerances of plus or minus ¼" on centers. Because of the accurate machine prefabrication of USS American Welded Wire Fabric the two concentric cages can be formed faster.

Complete technical information on USS American Welded Wire Fabric is available. Just write to American Steel & Wire, Dept. 0105, 614 Superior Avenue, N.W., Cleveland 13, Ohio.

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Water Pollution Control Federation

Effective the first of the year, the Federation of Sewage and Industrial Wastes Associations becomes the Water Pollution Control Federation. The monthly journal becomes the Journal of the Water Pollution Control Federation. This change resulted from a mail ballot following action the Board had at its meeting in Dallas last October. Dr. Mark Hollis, chief engineer of the Public Health Service is president of the Federation. Dr. Ralph Fuhrman is secretary of the Federation and Editor of the Journal. Offices are at 4435 Wisconsin Ave., Washington 16, D.C.

Control of Weeds Affecting Health

Control of ragweed, poison ivy, and other weeds of the Western United States that affect health will be discussed in two sessions of the Public Health Section during the third biennial meeting of the Weed Society of America in Denver, Colorado, February 22-25, 1960. The program will provide essential and basic information to health, park, public works, highway departments and other interested state and municipal agencies on the use and effectiveness, of the new herbicides in the control of weeds. Advances in herbicides, methods and equipment will also be covered. The toxicity of certain herbicides will be discussed.

Highway Conference

The School of Engineering, Albert Diefendorf, dean will hold the third annual Highway Conference on the campus of the College of the Pacific, Stockton, Calif., March 1 to 3, 1960.

Conference on Liquid and Gaseous Wastes

The Mid-Atlantic States Air Pollution Control Association and the New Jersey Sewage and Industrial Waste Association are cooperating to present, for the second consecutive year, a special conference on gaseous and liquid industrial wastes problems. This conference will include the following topics: Recognition and definition of the problem; methods of solution; examination of industrial processes, measurement of pollutants, laboratory and pilot plant studies of the treatment processes; design and construction of treatment devices; operation control; monitoring of effluents; and personnel requirements. The session on gaseous wastes will be held on March 29th; that on liquid wastes on March 30th. The meeting place is the Hotel Traymore, Atlantic City, New Jersey.

Adjusting Charges for Refuse Collection on a Volume Basis

Because it was felt that rates for refuse collection for commercial establishments were not covering the cost of the work, Snyder, Tex., R. L. Dunlap, City Manager, initiated a study of the refuse volume. Each of the businesses served was visited for six consecutive nights, as the refuse was collected, and the volume tabulated, this being converted for purposes of the study, into equivalent 32-gallon containers. Tabulations covering 220 customers showed that 164 of them produced from 13 to 60 containers per month.

On the basis of the study, rates were established as follows: For 12 containers per month or less, $3; for 200 containers $15; for the next 200 containers, 5 cents per can; and for the next 400 containers 1 cent per container. The change in charges nearly doubled the income from commercial establishments.

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Yale Bureau of Highway Traffic

Fellowships for the 1960-61 academic year are now available from the Bureau of Highway Traffic, Yale University, New Haven, Conn. The fellowships provide $175 per month for 8 months, plus tuition allowance of $800. For data on program and for application forms write the Bureau at Strathcona Hall, New Haven 11, Conn.

West Virginia Sewage & Industrial Wastes

The 1960 annual meeting of the West Virginia Sewage & Industrial Wastes Assn. will be held at the Prichard Hotel, Huntington, W. Va., March 23-24. Glen Fortney, State Dept. of Health, Charleston 5, W. Va., is secretary-treasurer.

NEWS OF ENGINEERS

D. B. BOYNTON, G. H. GRONQUIST and J. LONDON, long-time associates of D. B. STEINMAN, Consulting Engineers, have been taken into partnership. The firm will operate at 117 Liberty St., N. Y. 6, N. Y., under the name of Steinman, Boynton, Gronquist & London.

CLINTON BOGERT ENGINEERS is the new name of the former consulting firm of Bogert & Childs, Mr. Childs having retired.

WILLIAM L. HAAS has resigned as director of the Administrative Division of the Wisconsin Highway Commission.

HARRISON BLANKENSTEIN has been appointed Chief Engineer and HERMAN GINSBERG, Deputy Chief Engineer in the Office of the president, Borough of the Bronx, New York City. Both are registered professional engineers and career men in New York City service.

JOSEPH W. GUYTON has joined the traffic engineering staff of Harland Bartholomew & Associates in the St. Louis office. He holds a master's degree from Illinois and during service with the Army Engineers was an instructor in nuclear weapons.

GRIFFENHAGEN-KROEGER, INC., has been formed by combining Louis J. Kroeger & Associates with Griffenhagen & Associates to provide counseling and service in public administration and finance. Offices will be continued at 40 Wall St., N. Y., and in Chicago, Washington, San Francisco, Los Angeles and Philadelphia.

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City of Palo Alto is accepting applications from qualified persons for position of Asst. Supt. of Public Works. Position has administration of Street and Park Maintenance Divs. Park maintenance and construction experience desired; knowledge of street repair and maintenance necessary. Age to 45. Citizen. Desire college grad with CE degree as background. Must have 5 yrs. responsible administrative or supervisory experience. Starting salary dependent on qualifications. Liberal benefits.

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A man with considerable experience in technical sales work, estimating, preparing proposals, outside sales work with consulting engineers, advertising and sales promotion and training of sales personnel is available. Principal experience is in water, sewage and industrial wastes. Age 35, married, present location New York Metropolitan area, has BS degree, Navy veteran.

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Rockville, Maryland, a rapidly expanding residential suburb of Washington, D.C., with a population of 27,000, has an opening for an Assistant Public Works Director to supervise its Engineering Division and to assist in directing its overall public works operation, which includes water and sewer utilities. Qualifications: degree in engineering, several years' municipal experience and some supervisory experience in public works design, construction and maintenance. Position available February 1, 1960. Salary range $8,112-$9,152, in yearly increments, with generous fringe benefits. Submit complete resume, including personal history, education, experience and references.

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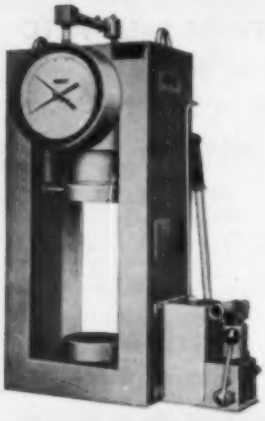

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The AST Reactor for Sludge Disposal

THE FIRST municipal application of the Atomized Suspension Technique (AST for short) for sewage sludge disposal is located at Beaconsfield, Quebec. At this installation, pictured herewith, settled sludge is concentrated to about 10 percent solids content and pumped to a storage tank in the small building. Here it is passed through a disintegrating machine to chop up fibrous material and pumped to the top of the AST reactor tower outside the building. The sludge is atomized with pressure nozzles as it passes into the empty tower.

Walls of the tower are held at a high temperature (1400°F. at the top; 1000°F. at the bottom) by four banks of electric heaters. These are controlled individually and automatically from a panel inside the building.

Water in the atomized spray flashes into superheated steam and the solid particles are completely dried by the time they have fallen half-way down the tower. At this point, air is introduced at low pressure from a compressor inside the building. The solid particles combine with the oxygen in the air and the organic material in them is burned to a dry, fine ash. Bacteria and odors are destroyed completely by the high temperature in the tower.

The line leading toward the left from the base of the tower is a jet condenser, in which the steam carrying the ash is cooled and condensed by sprays of cold water from the effluent of the settling tank. This condensate, with its entrained ash, is then passed down through the vertical scrubber in the left background and goes to the main pumping station which sends it into the plant outfall. Gaseous products of combustion are vented to the atmosphere from the narrow pipe in the left background.

At the present time, there is no provision for recovery and utilization of the large amount of heat in the exhaust steam from the reactor. It would be possible, however, to use it to produce hot water to heat buildings in the vicinity.

The reactor tower is a tube of stainless steel having an internal diameter of two feet and a height of twenty feet. Most of the external diameter of this unit is created by the electrical heating elements and insulation surrounding the tube.

AST was developed and patented in Canada, the U.S. and a number of other countries by the Pulp and Paper Research Institute of Canada in Montreal. It has application to many other fields of chemical processing and disposal of industrial wastes. The AST plant at Beaconsfield was designed, installed and operated by National Welding Company Limited, of Montreal, to handle the sanitary sludge from a total population of 12,000. The installed cost of the plant was $35,000. It occupies a ground area approximately 40 feet square.

Rural Water Supply in New Mexico

(*Continued from page* 100)

of justice. Fortunately, this man was as big as he was just. After explaining the new situation to him with the aid of a transit and some elementary notes on hydraulics, he made a hasty retreat and suggested to his community that they follow the original plans. This was done and the project completed.

The people we are working with in many instances are skilled artisans. They can weave, carve, lay bricks, make water-proof structures using rocks and clay, and construct buildings of mud which will last for generations. They plan, construct and operate complicated irrigation and drainage systems, but pipeline hydraulics are not easily understood. They can understand how a pump will raise water from a well to the surface of the ground, but the idea of the pump forcing the water to a storage tank on a hill above the wellsite is to them impossible. Many projects have been jeopardized by this lack of understanding. They fear that all their work will be to no avail, and that the engineers are making a grave error. Delegations come into the office and courteously explain that they would like to select a different tank site; the one proposed is not near enough to some members, or it will be difficult to dig the ditch. We point out of course that the location under discussion was selected to insure adequate pressure. The discussions go on and on until finally in a tone of utter exasperation one of the delegation will forcefully state that this site cannot be used because the water cannot run up the hill. We then explain the pump, the use of check valves and other appurtenances, all of which makes but little impression; if the water cannot run up the hill in a ditch, it cannot in a pipeline. So far, we have solved the issue by suggesting that they visit existing projects of a similar pattern, where working installations can be seen.

Since passage of the original bill, the Legislature has unanimously voted to grant an additional $150,000 each two years for continuance of the program. Total funds appropriated to date are $1,040,000. Eighty projects have been completed and 3,081 families presently served represent almost 18,700 people, allowing five members per family. At a total cost of $593,350.24 for seventy-one projects, the average cost per project is $8,357.04, the cost per dwelling unit is about $192.58, and the cost per person is about $32.

The average cost per dwelling unit of $192.58 is substantially below the maximum of $250 permitted in the law. This has enabled the department to construct more projects than originally contemplated in the appropriation requests. Certainly $32 per person is a small cost in consideration of the public health protection afforded.

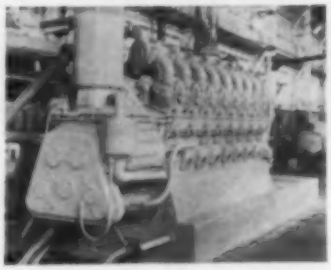
As pointed out previously, the associations develop according to leadership and local finances. Some have moved forward rapidly, others more slowly, and some are almost static. San Rafael in Valencia County has developed very rapidly and serves as an excellent example of what can be done. The membership has grown from seventy-five families to ninety. Sixty-four families are connected to the supply, using yard taps. About one-half of the sixty-four have sinks in their houses. There are about ninety washing machines in use and thirty members have tubs and lavatories; fifteen are using commodes. After completion of the original project, the association purchased and installed 5103 feet of ¾-inch, 208 feet of 1-inch, 1008 feet of 1½-inch, and 1700 feet of 4-inch pipe at a cost of $6,500, not including installation and labor. They have also installed fire hydrants and have hopes for a fire department.

New Mexico is well on the way toward solving its rural water supply problems. Progressive legislation adopted in bold forthright recognition of the situation has made this possible. Hauling contaminated, muddy river water for domestic use is rapidly disappearing from the rural scene.

Summary

The New Mexico Department of Public Health, by act of the Legislature, supervises a program for replacing unsafe water supplies in rural unincorporated communities with safe supplies. The State supplies funds for a well, pump, storage tank, supply line and appurtenances. Funds are allocated by formula according to the number of families to be served. The community, acting through an incorporated non-profit association, does all of the work and supplies local materials. The Health Department encourages the associations to expand beyond the legislative intent and provide comprehensive distribution systems, fire hydrants and other items necessary for a complete plant. The ultimate

Ever-important drainage in Louisiana parishes fully protected by large diesel engine driven pump



Jefferson-Plaquemines Drainage District, Gretna, Louisiana, has insured residents of their counties against flooding with purchase of two 1600 HP General Motors Diesel Engines for installation through a Western Gear Reduction Unit to a Woodin Screw Pump. System is designed for using either one engine or other to give double insurance that standby power will be available. A. G. SCHOONMAKER COMPANY, INC., furnished the two units and all accessory equipment and coordinated the ever important torsional analysis between engines, gear and pump. Photo shows one of the engines on test at A. G. SCHOONMAKER Plant, Sausalito, California.

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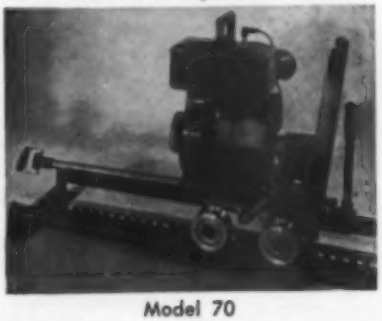

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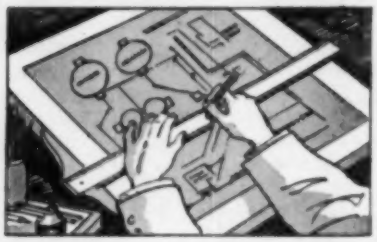

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(*Continued from page 122*)

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Accomplishments of Miami Metropolitan Government

According to a summary by the Miami-Metro News Bureau, the list of accomplishments by the Dade Co. Metropolitan Government in the short period of its existence has more than justified its creation. Here is what Metro did in its first year alone:

The number of county departments was reduced from 35 to 17.

A professional budget system was installed.

A 6½ percent reduction in the county tax was realized.

A civil service program was extended and nearly half of the county's employes received pay increase.

A modern encumbrance accounting system was adopted.

Tax collection and assessment is being centralized.

A new assessment program was put in operation. More efficient management of the idle funds of the county was accomplished.

Welfare and hospital programs were reorganized. Institutional hospital care was consolidated. The Sheriff's office, the County police, fire patrol and civil defense were combined into a single Public Safety Dept.

An analysis of area recreation needs was made and program policy for the future charted. County agencies concerned with public works were consolidated and reorganized along functional lines.

An expanded and accelerated highway program was started.

A Metropolitan traffic code was implemented. A Metropolitan court was established.

Uniform subdivision regulations were adopted.

Members of the Metro Commission are Chairman Ben McGahey, Joseph A. Boyd, Faris N. Cowart, Ralph A. Fossey, Alexander S. Gordon, Charles F. Hall, Robert M. Haverfield, Edwin L. Mason, John B. McLeod, Arthur H. Patten and Walter Weiss. O. W. Campbell is County Manager.

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PUBLIC WORKS

EQUIPMENT NEWS

Attachment for Caterpillar graders built for light and medium loading operations.

Shovel Loader Attachment

A new 1-yd. shovel-loader attachment for Caterpillar motor graders mounts on the front of the grader, allowing full-vision operation during loading or dumping. Once the mountings are added to a grader, the "GraderloadeR" can be installed or removed in minutes. Because of its front mounting, the bucket can be seen by the operator at all times. This loader was designed for fast loading of excess windrow material on road maintenance jobs. Other applications are materials handling, backfilling, snow removal and general stockpiling. With a reach height of 11 feet the unit easily clears truck sides and dumps in bed centers.

Martin - Caterpillar Dealers, or Martin Company, 620 Andrews Ave., Kewanee, Ill.

Circle No. 2-1 on the convenient reply card facing page 34.

Lift Station Odor Controller

Two new Alamask products for the control of malodors from wet wells and lift stations have been announced by Rhodia. Alamask RLT-630 is applied at the rate of 1 to 3 ppm by drip feeding or by use of ½ lb. per week in the wet wall for controlling pumping plant odors. Water dispersible Alamask RLT-630-X is applied by spraying a dilution of 2 to 4 oz. per gallon of water close to the liquid level at the rate of 1 to 3 gallons of this dilution per 100,000 gallons of sewage. For lift station malodors, Alamask RLT-630 is applied at a concentration of 0.5 to 1 ppm by drip feeding.

Rhodia, Inc., 60 East 56th St., New York, N. Y.

Circle No. 2-2 on the convenient reply card facing page 34.

Pipe Finder

This combination pipe finder-leak detector has completely transistorized circuits. There are independent circuits for each operation and many new materials such as printed circuits, indestructible fiberglass cases and single turn solid aluminum detecting loops have been used. Weighing only 12 pounds, the unit was developed for use by water departments and utility, pipeline and construction companies. Average battery life is more than 1500 hours of continuous operation, equivalent to a year of normal field use.

Fisher Research Laboratory, Inc., Palo Alto, California.

Circle No. 2-3 on the convenient reply card facing page 34.

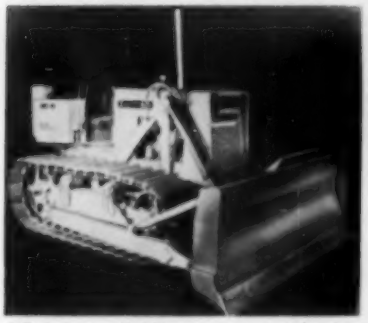
Hook-On Scraper

This multi-purpose scraper, with scarifying teeth, attaches to any 3-point hitch tractor. It will scarify, grade, level, scrape and backfill. It is available in 5½ and 6-foot widths and the three settings enable the operator to adjust teeth for scarifying, scarifying and grading, or for grading only. Straight sides of the Landscraper permit grading close to buildings and walls.

Independent Mfg. Co., Neodesha, Kans.

Circle No. 2-4 on the convenient reply card facing page 34.

Crawler Tractor



OC-9 is available as one-yard loader.

The Oliver OC-9, a 62 gross hp diesel crawler tractor, offers a new transmission that provides independent power to each track—controlling both speed and direction. It also features "powerized" steering with three types of turns. With little effort, the operator can spot-turn on one track or execute a counter-rotation turn—for the shortest turn possible. Or the operator can make gradual turns within any radius. The bare tractor weighs 9675 lb. Maximum drawbar pull is 16,900 lb.; with 1714 sq. in. of ground contact area, the ground pressure is only 5.6 lb. per sq. in. The OC-9 is also available in a factory-built, 1-yd. loader model, the OC-96.

The Oliver Corporation, 400 West Madison St., Chicago 6, Ill.

Circle No. 2-5 on the convenient reply card facing page 34.

Aerial Ladder

A new Series HLE revolving ladder has been added by the Powers-American Division of McCabe-Powers Body Company. The new ladder is designed to save time on overhead work by reaching jobs quickly, easily and safely. Elevation is by a hydraulic cylinder powered by an electric motor-driven pump. The motor, operated by the truck battery, is designed to work with 6- or 12-volt electric system and use of the motor has no appreciable effect on battery life. A manually-operated check valve regulates positioning and controls speed of descent. A handwheel rotates the ladder 360° in either direction and locks it in position.

McCabe-Powers Body Co., 5900 N. Broadway, St. Louis 15, Mo.

Circle No. 2-6 on the convenient reply card facing page 34.

Large Magnetic Drive Meter

A new larger-capacity magnetic drive sealed register water meter has been introduced by Rockwell. The 1-inch model has a capacity of 50 gallons per minute compared with capacities of 20 and 30 gpm respectively for the ⅝-inch and ¾-inch models. These sealed register meters provide a major design advance in domestic water metering. Special features are (1) a hermetically sealed register to end dirt, water and condensation on dials; (2) a powerful magnetic drive which eliminates the need for a stuffing box and exposed intermediate train; and (3) the oscillating piston principle for long life and accurate measurement. The entire unit contains only 15 stock parts, of which only two moving parts operate in contact with water. Straight reading registers calibrated in cubic feet or gallons with a center sweephand are furnished.

One-inch sealed register water meter.

Further information from Rockwell Mfg. Co., Municipal and Utility Div., 400 N. Lexington Ave., Pittsburgh 8, Pa.

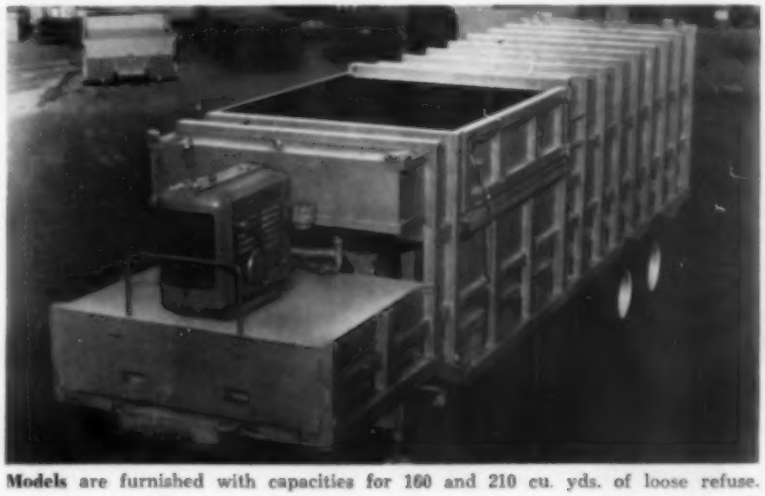
Circle No. 2-7 on the convenient reply card facing page 34.

Refuse Compaction Trailer

A new hydraulic compaction trailer for handling large volume accumulations of trash and refuse has been announced by Dempster Brothers. It is available in two sizes. The Model DB-42, which will hydraulically pack in approximately 160 cubic yards of loose refuse; and the Model DB-53, which will hold approximately 210 cubic yards of loose refuse. Cities already owning their own detachable container system of refuse storage may use these containers in conjunction with the new trailer by employing ramps or extended-mast, truck-mounted GRD's. The packing mechanism, which is controlled by one double-acting lever, moves with a thrust of 65,000 pounds. Power is from a single telescopic cylinder on a support platform. The packer head moves the complete length of the body for tighter packing, as well as for clean discharge when dumping. An 18-gallon sump at the front of the trailer gathers liquids when wet refuse is compacted.

Dept. CT-101, Dempster Brothers, Knoxville, Tenn.

Circle No. 2-8 on the convenient reply card facing page 34.



Models are furnished with capacities for 160 and 210 cu. yds. of loose refuse.

Sweeper

Brooms are driven by separate rear engine in new sweeper.

The Model TE (twin engine) Mobil sweeper has a separate rear engine to drive the sweeping mechanisms so that brooms operate at maximum efficiency at all times, completely independent of the forward speed. The heaviest debris at the curb line can be picked up in one pass. In addition to the twin engine feature, the Model TE has an automatic full floating feature for both rear pick up broom and gutter brooms. The spring tension adjustment for the "touch" of the bristles to the pavement is made originally by the operator. From then on, dips, intersections, inverted curbs and other irregularities are swept clean, as the brooms can sweep clean right through these depressed areas. Dirt hopper capacity is 3.2 cu. yds.

The Conveyor Co., Los Angeles 58, Calif.

Circle No. 2-9 on the convenient reply card facing page 34.

Chipper

Truck body houses chipper unit and tilts for dumping chips.

Asplundh has recently put on the market a tilt action truck body with a built-in brush chipper unit. The 12" brush chipper is mounted on any two-ton chassis with 102" cab axle; the Asplundh truck body has approximately 285 cubic feet of load space. There is plenty of room for wood chips and there is adequate storage for tools, ladders and miscellaneous equipment. Personnel quarters seat six crewmen comfortably plus the driver. The tilt body is designed for easy and quick dumping in a matter of seconds. The hydraulic hoist has dash controls within the truck cab.

Asplundh Chipper Co., 501 York Rd., Jenkintown, Penna.

Circle No. 2-12 on the convenient reply card facing page 34.

Handy Pump

A "Handy Pump" weighing only 13 pounds is handy for on-the-job cleaning of construction equipment and for watering hard-to-get-at park areas. Capacity is to 18 gpm. The ½-hp motor operates on AC or DC. A 2-inch self-priming centrifugal solids handling pump (solids to 1⅛ ins.) has a capacity range of 40 to 220 gpm; this is also available in 3, 4 and 6-inch sizes.

Gorman Rupp Co., Mansfield, Ohio.

Circle No. 2-10 on the convenient reply card facing page 34.

Water under pressure in the field can be provided by small centrifugal pump.

Tiltable Patcher

A new version of the Martin tiltable truck-mounted patcher allows greater road clearance when retracted. Up to eight inches clearance is possible when the highway patching unit is mounted on a 28-inch high truck frame. In normal operations, the tiltable patcher is mounted on the rear of the truck frame. It can be extended 31⅞ inches to roll 3⅞ inches below the pavement level and retracted to 20 inches when not in use. To match the roller angle to the slope of the road, the unit is center-pivoted to allow up to 13° variation. It follows the road slope regardless of the position of the truck. Although the unit adds only 700 lbs. to truck weight, it is possible to exert over 3½ tons pressure on the roller for patching broken pavement. Compaction pressure of 250 lbs. per square inch of roll width can be applied. Completely self - contained, the patcher has two spring-tension scraper blades and a built-in sprinkler system to prevent asphalt adhesion to the roll during rolling.

Martin Company, 620 Andrews Ave., Kewanee, Ill.

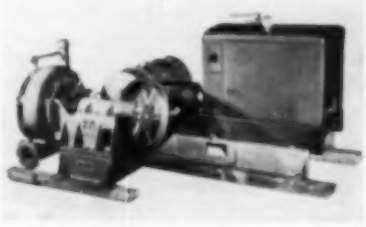
Circle No. 2-11 on the convenient reply card facing page 34.

Small Suction Dredge

This is an inexpensive small suction dredge for use in industrial and municipal water supply areas, shorefronts, rivers, channels or any area where removal of mud, silt, sand or gravel is a problem. This complete package consists of a pump; a gasoline, diesel or electric power unit with V-Belt drive; and fittings, fuel tank, gauges, etc. This package is arranged so that it can easily be placed on the purchaser's own hull or barge. The unit is available in 6", 8" or 10" pump sizes.

Morris Machine Works, Dredge Department, Baldwinsville, N.Y.

Circle No. 2-13 on the convenient reply card facing page 34.



Prefab Rest Stop

An all-aluminum rest station for use in private and public parks and road-side table areas, has been introduced, two models of the station now being available. One is 6½ ft. square, and the other 6½ by 5½ ft. These are about 7½ ft. high and have a roof pitched to the rear. Ribbed aluminum sheet is used throughout the structures for siding, roofing, and doors. To help the buildings blend into the landscape, a coarse bark pattern is rolled into the sheet. A special fence acts as a vision barrier in front of the small station. Both models are adaptable to any type of plumbing. Daylight illumination is provided by inserts of green plastic under the eaves.

Aluminum Company of America, 720 Alcoa Building, Pittsburgh 19, Pa.

Circle No. 2-14 on the convenient reply card facing page 34.

Flasher Lights

New five and seven-inch diameter flasher warning lights with a one-inch wide brilliant circle of light around the rim are being introduced by Pacific Mercury. These are available in amber and red, and offer great nighttime visibility and traffic safety. Flash rate of the lights is adjustable to meet specific state highway requirements. Lights are vapor-proof and therefore completely safe for use in the presence of gasoline or explosive vapors. Both models are available with tamper-proof switch and automatic turn-on as the sun goes down, turn-off when the sun rises.

Pacific Mercury, 13232 Leadwell, North Hollywood, Calif.

Circle No. 2-15 on the convenient reply card facing page 34.

Utility Tractors

Three 1960 Model multi-purpose Massey-Ferguson industrial rigs feature instant reverse with torque converter. These are the Models 1001 and 406 tractor shovels, and the Massey-Ferguson 204 industrial tractor. With full-time power steering and many attachments, all three of these new Massey-Ferguson units provide utility in digging, trenching, grading, terracing, landscaping, loading, unloading and stockpiling. Other features of the three units include simplified controls, power steering, individually controlled left and right brakes, and torque converter. Attachments for the tractor shovels include angle dozer, lift fork, swinging crane, scarifier, backhoe, rotary broom, Ram pick-up sweeper, Ram rotary snow blower and Ram leaf loader. The 1001 also has the Ram blacktop spreader attachment. Both the 1001 and the 406 have 1-cu. yd. (SAE rated) capacity buckets as standard equipment. Attachments for the 204 include the loader (it will convert into a fork lift, crane, angle dozer, straight dozer and scarifier); the backhoe; and the four-way scarifier-scraper.

Instant reverse and torque converter are features of the Model 204 tractor.

Massey-Ferguson Industrial Div., Block 1000 South West St., Wichita, Kans.

Circle No. 2-16 on the convenient reply card facing page 34.

Case Roadbuilding Line

At the showing in Bal Harbour, Fla., in early January, J. I. Case Co. announced a series of hydraulic drive tractors with air-cooled, all-weather cabs; a U. S. made small diesel tractor; and a large line of construction, roadbuilding and materials handling wheel and crawler tractors and equipment. Self-propelled scrapers, to be introduced in July, will have capacity ranges from 6½ to 18 cu. yds., with 80-hp diesel engines and 8-speed transmissions; added to the wheel loaders is the model W-3, of 15 cu. ft. bucket capacity, with a 47-hp engine and a hydraulic torque converter drive. The scraper is the S-20 model; operation is completely hydraulic; the first unit produced will be in the 6.5-yd. size. The W-3 loader is also the first of several units which will provide capacities to 3 yds.

J. I. Case Co., Racine, Wisc.

Circle No. 2-17 on the convenient reply card facing page 34.

First of a line of self-loading scrapers, Model S-20 has capacity of 6.5 cu. yds.

Also used as 6-in. drill for 1500 ft.

Core Drill

The Acker Presidentè is a new core drill with a capacity of 4500 ft. using an AX (2″) bit. The rig features a hydraulic drill head and a new patented automatic chuck. A power operated air brake and clutch are features not previously incorporated on drills of this capacity. The Presidente is available for skid mounting or truck mounting with diesel, gasoline or power take-off drive. A copy of bulletin 31 describing the new drill is available.

Acker Drill Co., Inc., Box 830, Scranton 2, Pa.

Circle No. 2-18 on the convenient reply card facing page 34.

Loader for IHC Tractors

A new, heavy duty loader for International tractors, designed to use the tractor's hydraulic system, is announced by Freeman. The main frame is of tubular construction, made in two pieces for easy installation and removal. The loader arms are 1″ x 4″ high carbon steel, and accommodate any of three different buckets: 40″ combination or material, and 66″ material bucket. Designated Model 725-A, the new loader fits International 300-330-340-35-460 tractors. It lifts over 1500 pounds to a height of 10 feet to bottom of the bucket.

Freeman Loader Corp., Blair Pike Road, Peru, Indiana.

Circle No. 2-19 on the convenient reply card facing page 34.

Rotary Mowers

Four new rotary mowers are now available from Allis-Chalmers. They are designed for grass areas along highways and on airports, and for finish mowing in parks, golf courses and cemeteries. They also cut and shred heavy weeds and brush and chop brush and tree prunings. The Model 166 mower, with 5½-ft. cut, is center-mounted for the Allis-Chalmers D-14 tractor. Two mowers with 5-foot cuts, Model 160, include a trail-type for use with any tractor or truck having PTO and standard ASAE drawbar; and a rear-mounted unit for quick attaching with hitch to A-C D-17, D-14, WD-45 and WD tractors. The Model 172 with 6-ft. cut is a trail type and can be used with any vehicle having PTO and a standard ASAE drawbar.

Allis-Chalmers Mfg. Co., Tractor Group, Milwaukee 1, Wisc.

Circle No. 2-20 on the convenient reply card facing page 34.

Curb Laying Machine

Automatic curb and gutter extruder.

This machine lays an integral curb and gutter, without forms, up to 30 ins. base width and 13 ins. curb height. Curb profile molds are easily changed. A stiff Portland cement concrete mix is used, preferably with aggregate less than ¾-in. This is extruded, the machine moving at speeds up to 5½ fpm. The compaction achieved by the machine is such that a man can stand on the placed concrete shortly after placement and 7-day tests show high strength. Controls regulate operation up or down hills or around corners.

Power Curbers, Inc., Salisbury, N. C.

Circle No. 2-21 on the convenient reply card facing page 34.

Portable Power

A recent addition to the line of Zeus electric power supply units is the model GW-300, offering 3000 watts of output power. As with other Zeus models, the GW-300 features a permanent magnet alternator which has no brushes, slip-rings or commutator to wear out, reducing periodic maintenance. The alternator, utilizing the high efficiency of a two-poled permanent magnet, is connected directly to a gasoline engine and delivers a full power rating for long periods of continuous running, without voltage loss or over heating. Other features include recoil or electric start; non-integral fuel tank and air-cooled operation. The low tone exhaust silencer assures exceptionally quiet operation. Accessories available are: auxiliary fuel tank, exhaust extension and special conversion units to permit the use of butane-propane or natural gas.

Further information from Pesco Products Div., Borg-Warner Corp., 3310 Vanowen St., Burbank, Calif.

Circle No. 2-22 on the convenient reply card facing page 34.

Wheel Tractor

A four-wheel-drive tractor especially designed for light industrial and construction work is announced by Detroit Tractor. Designated the W4G062, it is available in four different, hydraulically operated and ready equipped models: Bulldozer, grader clam, roll bucket and loader. The Bulldozer unit includes scarifier rack and wing plates which can be easily detached. The blade is simple to remove for replacement with other attachments. For plowing jobs it may be set at a 15° right or left angle. Changing the blade is a simple operation that takes only a moment.

Detroit Tractor, Ltd., Muskegon, Mich.

Circle No. 2-23 on the convenient reply card facing page 34.

35-Ton Roller

Roller has pivoting seat and controls.

A new 35-ton rubber-tired self-propelled roller weighs 21,700 lbs., empty, 70,000 lbs. when fully ballasted. It is provided with GM 4-71, 125 hp diesel power, Allison transmission and torque converter and Clark heavy-duty rear end. Equipped with seven 13:00 x 24 wide-tread 90-lb. tires, it gives an 8-ft. coverage. Tires for 120 lbs. pressure can be furnished when desired. Wheel loads vary from 3100 lbs. to 10,000 lbs. per wheel, depending on ballast. All wheels oscillate. Instruments, control levers and seat are mounted on an arm revolving on a central column, allowing complete control and full vision from any position. The manufacturer states this roller will meet all state highway specifications and is particularly suitable for the compaction of base materials and asphaltic concrete. It is also effective for the compaction of earthfill and crushed rock.

Shovel Supply Co., Box 1369, Dallas 21, Texas.

Circle No. 2-24 on the convenient reply card facing page 34.

3-in-1 Spreader

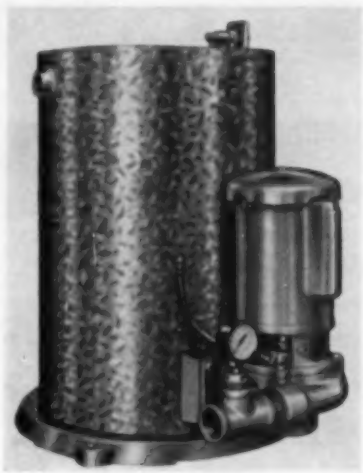
The work advantage of three one-man spreaders in the same rig are incorporated in the multi-purpose, HI-WAY Model "Y-2" reversible spreader. Designed for sealcoating, ice control and road widening, this is a complete unit, including body, engine and spinner, which can be reversed in 15 minutes. Mounted forward on the left side for ice control, the 18-inch diameter spinner spreads evenly in widths of 5 to 40 feet with complete visual control. Material is spread ahead of the rear wheels for extra traction without loss onto road shoulders. For sealcoating the body is reversed, placing the spinner at the right rear. In this position, with the spinner removed, the spreader can unload aggregate for road-widening or windrow to the right side of the truck. Operation is by one man from the cab.

Spinner precedes rear wheels for ice control; body reversed for other jobs.

Highway Equipment Company, Dept. H41-6, 616 D Ave., N. W., Cedar Rapids, Ia.

Circle No. 2-25 on the convenient reply card facing page 34.

Water Seal Units



For maintaining a clean water supply under pressure to the packing glands of sewage pumps, Pacific Pumping Company builds a series of "water seal units." A mechanical float valve admits city water to a receiver, with a positive, visible break between the city water supply and the water in the receiver, thus conforming to city and state sanitary codes. These water seal units consist of the receiver—32 or 64 gallons—a choice of centrifugal or turbine type pump, a float valve, gauge, and relief valve or bypass-tubing. Standard capacities range from 3 to 30 gpm with operating pressures from 15 to 100 lbs.

Pacific Pumping Co., Box 6188, Oakland 3, Calif.

Circle No. 2-26 on the convenient reply card facing page 34.

Derrick

Rectangular side legs and an extra-long middle leg hydraulic cylinder are two of the features of the new Holan Series 3750 hydraulic derrick. The unit is rated as a 12,000-pound capacity derrick, capable of setting poles 75 feet in length, but it has been tested at 22,000 pounds. One man can raise the derrick in 35 seconds, stow it in position in 40 seconds. A super-sensitive hydraulic system with a pump driven by power take-off controls every movement. The working range is 195°. It swings from its over-the-cab storage position to within 5 feet of the ground for easy threading of the winch line.

Holan Corporation, 4100 West 150th St., Cleveland 35, Ohio.

Circle No. 2-27 on the convenient reply card facing page 34.

Utility Field Houses

Two all-steel utility buildings are designed for building and construction crew field houses. Both provide a sure safeguard for tools and equipment. They are prefabricated and easy to erect. Also they can be readily dismantled for moving to another job site. The 7 ft. x 7 ft. x 7 ft. Stor-House provides an excellent contractor's field house for any construction job. It is compact and convenient, and comes complete in pre-punched sections, ready for speedy assembly with ordinary tools. The "101" Building is a larger utility building which comes in a variety of sizes. It is very flexible; floor plans can be laid out to suit specific requirements.

Martin Steel Corp., Mansfield, O.

Circle No. 2-28 on the convenient reply card facing page 34.

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WORTH SEEING

Here are twelve of 35 prize-winning entries displayed in a Museum of unusual Traffic Signs at Toledo, Ohio, by the Cataphote Corp., pioneer maker of reflective traffic marking materials. These examples of wit and wisdom include the sign at upper left, located in Alberta, Canada, which bears the Cree Indian word for "Whoa". (Crees have no word for "Stop".)

Center picture No. 5 is not in Europe but in Maine, where all places named are right in the state. There, even China is only 94 miles away. Nebraska officials report that the "We Are Not Fooling—30 MPH" sign, No. 7 really works at a sudden dangerous turn where standard signs had been ignored. Many others use humor to make their point more forceful and clear.

CANCER'S DANGER SIGNALS

CAN BE SAFETY SIGNALS

You can do **two things** to guard yourself against cancer: Have an annual health checkup. Alert yourself to the seven danger signals that could mean cancer:

1. Unusual bleeding or discharge. 2. A lump or thickening in the breast or elsewhere. 3. A sore that does not heal. 4. Change in bowel or bladder habits. 5. Hoarseness or cough. 6. Indigestion or difficulty in swallowing. 7. Change in a wart or mole.

If your signal lasts longer than two weeks, go to your physician. Give him the chance to give you the chance of a lifetime.

AMERICAN CANCER SOCIETY

by Arthur K. Akers

★ **Joseph W. Jackman** is appointed to the newly-created post of director of sales for Sparling Meter Co., El Monte, Calif., which was recently merged with Hersey Meter Co. of Dedham, Mass.

Mr. Bailey

★ **J. Ferris Bailey,** general manager and secretary of the Texas Vitrified Pipe Co. and Southwestern Plastic Pipe Co., has been appointed executive vice president. **David E. Clemens** becomes a director and secretary and general manager of the clay pipe company. **E. W. Hendrick** continues as managing head of the plastic pipe company and has been elected a director and secretary of the firm.

★ **Dick Chinn,** manager of market research, Massey-Ferguson Industrial Division at Wichita, was elected president of the newly organized Industrial Equipment Manufacturers Council. **John Scowcroft** of Sherman Products Corp. was elected vice president, **Jim Wormley** of Deere & Co., treasurer.

★ **John Vecchio** has been appointed manager, Central Industrial Division, A. Y. McDonald Mfg. Co. of Dubuque, Iowa. He will oversee sales operations of 21 branch locations.

★ There is a new lighting standards manufacturer in the ring now, Daniels Standards, Inc., of Nashville with a new plant at Humboldt, Tenn. It is headed by **Gordon E. Daniels,** formerly with Kerrigan Iron Works Co.

★ International Salt Co. now has **Henry E. Kalter** in its Chicago office as Highway Sales engineer to work with Illinois highway engineers on soil stabilization and ice control matters.

★ **Norman L. Barr** was elected vice president, Keasbey & Mattison Co., Ambler, Pa. He has been general sales manager for the past three years.

★ Valley Mfg. Co., Valley, Neb., announces it begins production of prestressed concrete forms early this year. A separate Steel Form Division has been set up under **Glenn I. Anderson** as manager.

★ **Dorace Dodd** is appointed assistant manager Tractor Division, The Eimco Corp., with southern headquarters in Birmingham, Ala.

★ **George W. Kelsey,** vice president B-I-F Industries, Providence, has been installed as president of the Water and Sewage Works Manufacturers Association. He has represented his firm on the WSMA Board for the past five years.

Mr. Kelsey

Mr. Giorgi

★ **Robert A. Giorgi** is named manager of market development for General Electric two-way radio, Lynchburg, Va.

★ **J. K. Neubauer** is promoted to assistant general sales manager, Standard Steel Works Inc., North Kansas City, Mo.

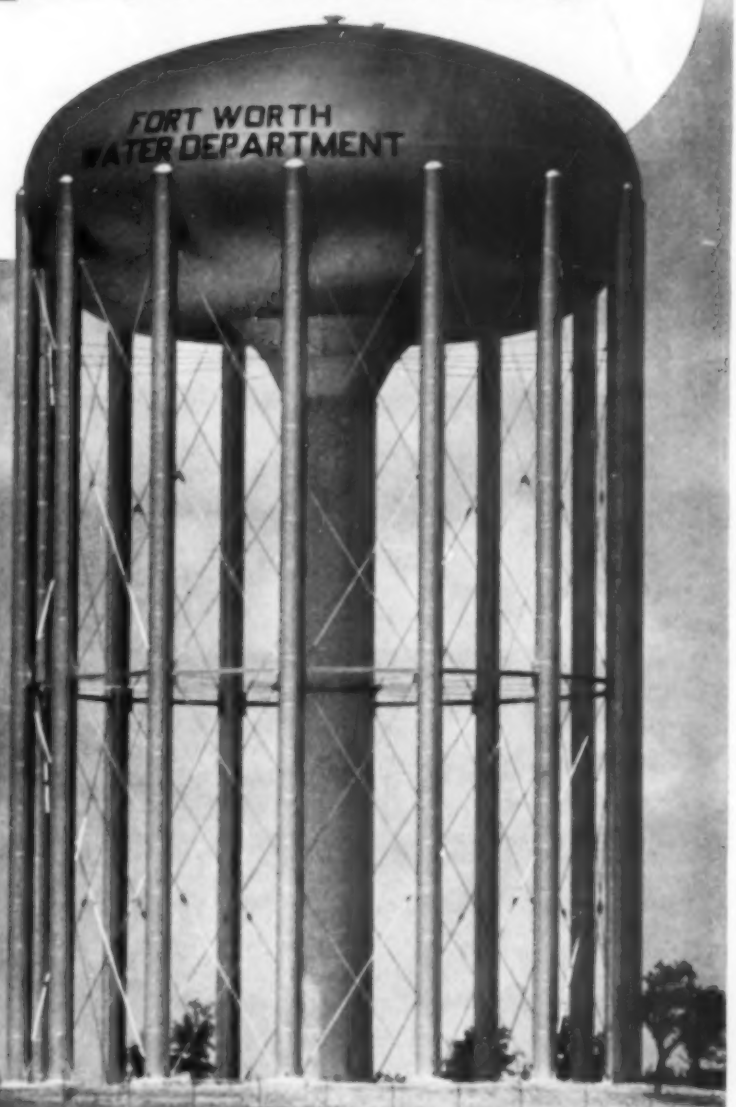
★ Natco Corporation of Pittsburgh is converting its Port Murray, N. J., plant to production of vitrified clay sewer pipe and allied products, better to serve its New England and middle Atlantic markets.

★ The customer was buying a fountain pen for his son's Christmas present. "A surprise, I suppose?" observed the clerk. "I'll say it is: he's expecting a convertible."

HORTON Spheroidal ELEVATED TANKS

. . . new functional beauty for efficient water storage

by CB&I



This is the striking 2,000,000-gallon Horton Spheroidal elevated water tank built by CB&I for the City of Fort Worth, Texas. It is 105 ft. in dia. and 126 ft. to the bottom.

The new Spheroidal design continues CB&I's tradition of providing graceful, contemporary tanks for America's most progressive communities. Economical, too, because Spheroidals use less steel more effectively. Capacities range from 200,000 to 3,000,000 gallons.

Modern Horton elevated tanks are products of CB&I's *coordinated services*, which form a single source and responsibility for designing, fabrication and erection. The result is *craftsmanship in steel*, skillfully developed over seven decades of experience.

Write for additional details.

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And, of course, the right plastics make the whole chlorinator chlorine-proof.

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